FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-569.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Marlow-As-DET
Property	2 Wren Walk, Southampton, Botley, SO32 2DX		

SAP Rating	91 B	**DER**	10.76	**TER**	20.54
Environmental	92 A	**% DER<TER**	47.63		
CO_2 Emissions (t/year)	0.56	**DFEE**	55.65	**TFEE**	64.67
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.94		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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DWELLING AS BUILT

Detached House, total floor area 80 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) 20.54 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.76 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)64.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 4.46 (measured in this dwelling)
Maximum 10.0 OK

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

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: No cylinder

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.43 m², No overhang
Windows facing West: 10.63 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.033 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000 (1b)	x	2.5400 (2b)	=	101.6000	(1b) - (3b)
First floor	40.0000 (1c)	x	2.6300 (2c)	=	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1934	(8)
Pressure test		Yes	
Measured/design AP50		4.4600	
Infiltration rate		0.4164	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4164	(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	0.5309	0.5205	0.5101	0.4581	0.4477	0.3956	0.3956	0.3852	0.4164	0.4477	0.4685	0.4893	(22b)
Effective ac	0.6409	0.6355	0.6301	0.6049	0.6002	0.5783	0.5783	0.5742	0.5867	0.6002	0.6097	0.6197	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		11908.2940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.8537	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0557	(36)
Total fabric heat loss					(33) + (36) =		72.2872	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.7409	43.3674	43.0013	41.2816	40.9599	39.4621	39.4621	39.1848	40.0390	40.9599	41.6108	42.2912	(38)
Heat transfer coeff	116.0281	115.6546	115.2885	113.5688	113.2471	111.7493	111.7493	111.4720	112.3263	113.2471	113.8980	114.5784	(39)
Average = Sum(39)m / 12 =												113.5673	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4504	1.4457	1.4411	1.4196	1.4156	1.3969	1.3969	1.3934	1.4041	1.4156	1.4237	1.4322	(40)
HLP (average)												1.4196	(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												2.4629	(42)
Average daily hot water use (litres/day)												92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

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Distribution loss  (46)m = 0.15 x (45)m
              22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
             165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (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
             165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   1623.6559 (64)
Heat gains from water heating, kWh/month
              53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m        123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431   123.1431 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              19.5599    17.3729    14.1286    10.6963     7.9956     6.7502     7.2938     9.4808    12.7251    16.1575    18.8582    20.1035 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             219.4405   221.7177   215.9794   203.7634   188.3429   173.8497   164.1674   161.8903   167.6286   179.8446   195.2651   209.7582 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143    35.3143 (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)
             -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
              72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
             374.2635   372.2066   358.7657   337.0585   315.0029   293.7267   279.8841   285.8241   296.9515   318.8704   344.0726   362.9888 (73)


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6. Solar gains
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[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
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North                                    7.4300           10.6334          0.4600            0.0000            0.7700           27.9840 (74)
West                                     7.3000           19.6403          0.4600            0.0000            0.7700           50.7830 (80)
West                                     3.3300           19.6403          0.4600            0.0000            0.7700           23.1654 (80)
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Solar gains   101.9324   198.1377   329.1061   493.4142   622.4404   646.3909   611.5146   512.3873   386.3338   235.3095   126.7269    84.1404 (83)
Total gains   476.1960   570.3442   687.8717   830.4726   937.4432   940.1176   891.3987   798.2114   683.2853   554.1798   470.7994   447.1292 (84)


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7. Mean internal temperature (heating season)
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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          28.5091    28.6012    28.6920    29.1265    29.2092    29.6007    29.6007    29.6744    29.4487    29.2092    29.0423    28.8698
alpha         2.9006     2.9067     2.9128     2.9418     2.9473     2.9734     2.9734     2.9783     2.9632     2.9473     2.9362     2.9247
util living area
               0.9871     0.9775     0.9543     0.8958     0.7884     0.6389     0.5050     0.5681     0.7927     0.9395     0.9799     0.9892 (86)

MIT           18.6555    18.9136    19.3744    19.9854    20.4938    20.8146    20.9328    20.9040    20.6228    19.9411    19.1959    18.6208 (87)
Th 2          19.7249    19.7285    19.7320    19.7483    19.7514    19.7657    19.7657    19.7684    19.7602    19.7514    19.7452    19.7387 (88)
util rest of house
               0.9841     0.9724     0.9435     0.8705     0.7362     0.5491     0.3811     0.4427     0.7201     0.9197     0.9744     0.9868 (89)
MIT 2         16.6339    17.0103    17.6765    18.5480    19.2283    19.6210    19.7325    19.7158    19.4200    18.5083    17.4334    16.5912 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1125 (91)
MIT           16.8613    17.2245    17.8675    18.7097    19.3707    19.7553    19.8675    19.8495    19.5553    18.6695    17.6317    16.8195 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT  16.7113    17.0745    17.7175    18.5597    19.2207    19.6053    19.7175    19.6995    19.4053    18.5195    17.4817    16.6695 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9726     0.9557     0.9187     0.8392     0.7098     0.5360     0.3759     0.4349     0.6945     0.8913     0.9586     0.9768 (94)
Useful gains 463.1572   545.0693   631.9467   696.9248   665.4140   503.9167   335.0722   347.1225   474.5461   493.9305   451.3126   436.7433 (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
            1440.0628  1408.0320  1293.2526  1097.0405   851.6944   559.3341   348.3803   367.8028   595.9286   896.8635  1182.4575  1428.7380 (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
             726.8178   579.9109   492.0116   288.0833   138.5926     0.0000     0.0000     0.0000     0.0000   299.7822   526.4243   738.0440 (98)
Space heating                                                                                                                 3789.6668 (98)
Space heating per m2                                                                                                 (98) / (4) =     47.3708 (99)


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8c. Space cooling requirement
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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4187.4771	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.8178	579.9109	492.0116	288.0833	138.5926	0.0000	0.0000	0.0000	0.0000	299.7822	526.4243	738.0440	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	803.1136	640.7856	543.6593	318.3241	153.1410	0.0000	0.0000	0.0000	0.0000	331.2510	581.6844	815.5183	(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													
	165.3265	144.9838	150.5329	132.5472	128.1546	112.0209	105.2241	118.7262	119.5455	137.5716	148.4786	160.5440	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8894	89.8413	89.7295	89.4666	88.9338	87.3000	87.3000	87.3000	87.3000	89.4684	89.7760	89.9112	(217)
Fuel for water heating, kWh/month													
	183.9221	161.3776	167.7631	148.1527	144.1011	128.3171	120.5316	135.9979	136.9365	153.7655	165.3878	178.5584	(219)
Water heating fuel used												1824.8115	(219)
Annual totals kWh/year													
Space heating fuel - main system												4187.4771	(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)												345.4340	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) =										-1264.5955		-1264.5955	(233)
Total delivered energy for all uses												5168.1271	(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	4187.4771	0.2160	904.4951	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.8115	0.2160	394.1593	(264)
Space and water heating			1298.6543	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	345.4340	0.5190	179.2802	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total CO2, kg/year			860.5345	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.7600	(273)

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

DER		10.7600	ZC1
Total Floor Area	TFA	80.0000	
Assumed number of occupants	N	2.4629	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2545	ZC2
CO2 emissions from cooking, equation (L16)		2.2264	ZC3
Total CO2 emissions		29.2408	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.2408	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000 (1b)	x	2.5400 (2b)	=	101.6000 (1b) - (3b)	
First floor	40.0000 (1c)	x	2.6300 (2c)	=	105.2000 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1451	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3951	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3951	(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	0.5037	0.4938	0.4840	0.4346	0.4247	0.3753	0.3753	0.3654	0.3951	0.4247	0.4445	0.4642	(22b)
Effective ac	0.6269	0.6219	0.6171	0.5944	0.5902	0.5704	0.5704	0.5668	0.5780	0.5902	0.5988	0.6077	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			17.8600	1.3258	23.6780			(27)
GF B&B J150 P/A=0.40			40.0000	0.1300	5.2000			(28a)
EW Brick AAC015	135.9700	19.9900	115.9800	0.1800	20.8764			(29a)
Plane Ceiling	40.0000		40.0000	0.1300	5.2000			(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0844			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.7234	(36)
Total fabric heat loss (33) + (36) =	67.8078	(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	42.7796	42.4434	42.1139	40.5661	40.2765	38.9285	38.9285	38.6788	39.4477	40.2765	40.8624	41.4748	(38)
Heat transfer coeff	110.5874	110.2513	109.9217	108.3739	108.0844	106.7363	106.7363	106.4866	107.2555	108.0844	108.6702	109.2826	(39)
Average = Sum(39)m / 12 =												108.3726	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3823	1.3781	1.3740	1.3547	1.3511	1.3342	1.3342	1.3311	1.3407	1.3511	1.3584	1.3660	(40)
HLP (average)												1.3547	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6811	19.8370	20.4700	17.8462	17.1239	14.7766	13.6927	15.7126	15.9002	18.5302	20.2272	21.9654	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2240	48.1800	44.7974	44.4012	41.1404	42.5118	44.4012	44.7974	48.1800	48.4543	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.1660	177.4707	184.6467	163.7723	158.5605	139.6513	133.7965	149.1518	150.7990	171.7147	183.3021	197.3949	(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													
	202.1660	177.4707	184.6467	163.7723	158.5605	139.6513	133.7965	149.1518	150.7990	171.7147	183.3021	197.3949	(64)
								Total per year (kWh/year) = Sum(64)m =				2012.4265	(64)
Heat gains from water heating, kWh/month													
	63.0161	55.2780	57.4202	50.7585	49.0583	43.0400	40.9801	45.9299	46.4449	53.1203	56.9505	61.4297	(65)

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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	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.5628	17.3755	14.1307	10.6979	7.9968	6.7512	7.2949	9.4822	12.7270	16.1599	18.8609	20.1065	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(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)													
	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)													
	84.6990	82.2590	77.1777	70.4979	65.9385	59.7777	55.0808	61.7337	64.5068	71.3982	79.0979	82.5668	(72)
Total internal gains													
	386.6453	384.2950	370.2307	347.9021	325.2211	303.3216	289.4861	296.0492	307.8053	330.3456	356.1668	375.3744	(73)

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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	7.3500	10.6334	0.6300	0.7000	0.7700	23.8853	(74)
West	10.5100	19.6403	0.6300	0.7000	0.7700	63.0844	(80)

Solar gains	86.9697	169.0525	280.7966	420.9903	531.0835	551.5217	521.7629	437.1805	329.6250	200.7678	108.1244	71.7895	(83)
Total gains	473.6150	553.3475	651.0273	768.8924	856.3046	854.8432	811.2490	733.2297	637.4303	531.1134	464.2913	447.1640	(84)

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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	50.2368	50.3900	50.5410	51.2628	51.4002	52.0494	52.0494	52.1714	51.7974	51.4002	51.1231	50.8366	
alpha	4.3491	4.3593	4.3694	4.4175	4.4267	4.4700	4.4700	4.4781	4.4532	4.4267	4.4082	4.3891	
util living area													
	0.9980	0.9957	0.9881	0.9586	0.8746	0.7157	0.5566	0.6271	0.8719	0.9806	0.9962	0.9985	(86)
MIT	19.4523	19.6203	19.9278	20.3501	20.7098	20.9191	20.9795	20.9659	20.7909	20.3168	19.8147	19.4306	(87)
Th 2	19.7769	19.7801	19.7833	19.7983	19.8011	19.8141	19.8141	19.8166	19.8091	19.8011	19.7954	19.7895	(88)
util rest of house													
	0.9973	0.9942	0.9835	0.9419	0.8247	0.6142	0.4176	0.4851	0.7998	0.9700	0.9945	0.9979	(89)
MIT 2	17.7327	17.9800	18.4290	19.0410	19.5201	19.7617	19.8070	19.8030	19.6388	19.0060	18.2749	17.7093	(90)
Living area fraction									fLA = Living area / (4) =			0.1125	(91)
MIT	17.9261	18.1646	18.5976	19.1882	19.6539	19.8919	19.9389	19.9339	19.7684	19.1535	18.4481	17.9029	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9261	18.1646	18.5976	19.1882	19.6539	19.8919	19.9389	19.9339	19.7684	19.1535	18.4481	17.9029	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9910	0.9770	0.9306	0.8173	0.6215	0.4330	0.5003	0.7968	0.9615	0.9915	0.9965	(94)
Useful gains	471.4949	548.3480	636.0407	715.5536	699.8856	531.2981	351.2730	366.8259	507.8973	510.6719	460.3676	445.6035	(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													
	1506.8784	1462.4347	1329.7865	1114.9774	859.6934	564.8364	356.3861	376.3097	607.9686	924.4990	1233.2038	1497.4918	(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													
	770.3253	614.2663	516.1469	287.5851	118.8970	0.0000	0.0000	0.0000	0.0000	307.8874	556.4420	782.6049	(98)
Space heating												3954.1549	(98)
Space heating per m2											(98) / (4) =	49.4269	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4233.5705	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	770.3253	614.2663	516.1469	287.5851	118.8970	0.0000	0.0000	0.0000	0.0000	307.8874	556.4420	782.6049	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	824.7595	657.6727	552.6198	307.9069	127.2987	0.0000	0.0000	0.0000	0.0000	329.6439	595.7624	837.9067	(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													
	202.1660	177.4707	184.6467	163.7723	158.5605	139.6513	133.7965	149.1518	150.7990	171.7147	183.3021	197.3949	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0965	87.9212	87.5002	86.4544	84.3378	80.3000	80.3000	80.3000	80.3000	86.5044	87.6677	88.1663	(217)
Fuel for water heating, kWh/month													
	229.4824	201.8520	211.0243	189.4321	188.0064	173.9119	166.6208	185.7432	187.7945	198.5040	209.0874	223.8892	(219)
Water heating fuel used												2365.3482	(219)
Annual totals kWh/year													
Space heating fuel - main system												4233.5705	(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)												345.4850	(232)
Total delivered energy for all uses												7019.4037	(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	4233.5705	0.2160	914.4512	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2365.3482	0.2160	510.9152	(264)
Space and water heating			1425.3664	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	345.4850	0.5190	179.3067	(268)
Total CO2, kg/m2/year			1643.5981	(272)
Emissions per m2 for space and water heating			17.8171	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2413	(272b)
Emissions per m2 for pumps and fans			0.4866	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.8171 * 1.00) + 2.2413 + 0.4866, rounded to 2 d.p.			20.5400	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000 (1b)	x	2.5400 (2b)	=	101.6000	(1b) - (3b)
First floor	40.0000 (1c)	x	2.6300 (2c)	=	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1451	(8)
Pressure test			Yes	
Measured/design AP50			4.4600	
Infiltration rate			0.3681	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3681	(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	0.4693	0.4601	0.4509	0.4049	0.3957	0.3497	0.3497	0.3405	0.3681	0.3957	0.4141	0.4325	(22b)
Effective ac	0.6101	0.6058	0.6016	0.5820	0.5783	0.5611	0.5611	0.5580	0.5677	0.5783	0.5857	0.5935	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		11908.2940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.8537	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0557	(36)
Total fabric heat loss					(33) + (36) =		72.2872	(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	41.6367	41.3449	41.0588	39.7154	39.4640	38.2939	38.2939	38.0772	38.7446	39.4640	39.9725	40.5041	(38)
Heat transfer coeff	113.9239	113.6321	113.3461	112.0026	111.7512	110.5811	110.5811	110.3645	111.0318	111.7512	112.2597	112.7913	(39)
Average = Sum(39)m / 12 =												112.0014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4240	1.4204	1.4168	1.4000	1.3969	1.3823	1.3823	1.3796	1.3879	1.3969	1.4032	1.4099	(40)
HLP (average)												1.4000	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

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	(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	(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	(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	(59)

Heat gains from water heating, kWh/month

	32.1315	28.1024	28.9992	25.2822	24.2589	20.9336	19.3980	22.2595	22.5254	26.2511	28.6552	31.1176 (65)

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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	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	19.5599	17.3729	14.1286	10.6963	7.9956	6.7502	7.2938	9.4808	12.7251	16.1575	18.8582	20.1035 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143 (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)

	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144 (71)

Water heating gains (Table 5)

	43.1875	41.8191	38.9774	35.1141	32.6060	29.0744	26.0726	29.9187	31.2852	35.2838	39.7988	41.8248 (72)

Total internal gains

	342.1309	340.8526	329.0283	309.5167	288.8874	269.6172	257.4768	261.2327	271.5818	291.2287	313.8650	331.6295 (73)

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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	7.4300	10.6334	0.4600	0.0000	0.7700	27.9840	(74)
West	7.3000	19.6403	0.4600	0.0000	0.7700	50.7830	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

Solar gains	101.9324	198.1377	329.1061	493.4142	622.4404	646.3909	611.5146	512.3873	386.3338	235.3095	126.7269	84.1404	(83)
Total gains	444.0633	538.9902	658.1344	802.9309	911.3277	916.0082	868.9914	773.6201	657.9156	526.5382	440.5919	415.7699	(84)

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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	29.0357	29.1103	29.1837	29.5338	29.6002	29.9134	29.9134	29.9721	29.7920	29.6002	29.4661	29.3272	
alpha	2.9357	2.9407	2.9456	2.9689	2.9733	2.9942	2.9942	2.9981	2.9861	2.9733	2.9644	2.9551	
util living area	0.9893	0.9804	0.9584	0.9015	0.7952	0.6464	0.5118	0.5779	0.8030	0.9457	0.9830	0.9912	(86)
MIT	18.6471	18.9061	19.3686	19.9786	20.4906	20.8122	20.9320	20.9014	20.6141	19.9246	19.1778	18.6072	(87)
Th 2	19.7449	19.7477	19.7505	19.7633	19.7657	19.7770	19.7770	19.7790	19.7726	19.7657	19.7608	19.7558	(88)
util rest of house	0.9868	0.9760	0.9486	0.8775	0.7442	0.5572	0.3878	0.4524	0.7326	0.9277	0.9784	0.9891	(89)
MIT 2	17.6202	17.8789	18.3367	18.9348	19.4044	19.6761	19.7537	19.7418	19.5327	18.8982	18.1602	17.5881	(90)
Living area fraction									fLA = Living area / (4) =			0.1125	(91)
MIT	17.7358	17.9945	18.4528	19.0522	19.5266	19.8040	19.8863	19.8723	19.6543	19.0137	18.2747	17.7027	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7358	17.9945	18.4528	19.0522	19.5266	19.8040	19.8863	19.8723	19.6543	19.0137	18.2747	17.7027	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9672	0.9349	0.8603	0.7327	0.5594	0.3997	0.4630	0.7244	0.9128	0.9704	0.9842	(94)
Useful gains	435.6642	521.3141	615.3039	690.7545	667.7718	512.4278	347.3693	358.1678	476.6012	480.6331	427.5316	409.2129	(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	1530.6553	1487.9552	1354.8054	1137.0720	874.6368	575.4590	363.4030	383.2140	616.7088	940.2416	1254.4710	1522.9923	(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	814.6734	649.5828	550.1891	321.3486	153.9076	0.0000	0.0000	0.0000	0.0000	341.9488	595.3963	828.6519	(98)
Space heating												4255.6985	(98)
Space heating per m2											(98) / (4) =	53.1962	(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	1039.4627	818.3004	838.7699	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7899	0.8491	0.8101	0.0000	0.0000	0.0000	0.0000	(101)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	821.0426	694.8075	679.4659	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1162.4462	1105.5878	995.6396	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	245.8106	305.6206	235.2333	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												786.6644	(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	61.4527	76.4051	58.8083	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												196.6661	(107)
Space cooling per m2												2.4583	(108)
Energy for space heating												53.1962	(99)
Energy for space cooling												2.4583	(108)
Total												55.6546	(109)
Dwelling Fabric Energy Efficiency (DFEE)												55.7	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000 (1b)	x	2.5400 (2b)	=	101.6000	(1b) - (3b)
First floor	40.0000 (1c)	x	2.6300 (2c)	=	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1451	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3951	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3951	(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	0.5037	0.4938	0.4840	0.4346	0.4247	0.3753	0.3753	0.3654	0.3951	0.4247	0.4445	0.4642	(22b)
Effective ac	0.6269	0.6219	0.6171	0.5944	0.5902	0.5704	0.5704	0.5668	0.5780	0.5902	0.5988	0.6077	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			17.8600	1.3258	23.6780			(27)
GF B&B J150 P/A=0.40			40.0000	0.1300	5.2000			(28a)
EW Brick AAC015	135.9700	19.9900	115.9800	0.1800	20.8764			(29a)
Plane Ceiling	40.0000		40.0000	0.1300	5.2000			(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0844			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.7234	(36)
Total fabric heat loss (33) + (36) =	67.8078	(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	42.7796	42.4434	42.1139	40.5661	40.2765	38.9285	38.9285	38.6788	39.4477	40.2765	40.8624	41.4748	(38)
Heat transfer coeff	110.5874	110.2513	109.9217	108.3739	108.0844	106.7363	106.7363	106.4866	107.2555	108.0844	108.6702	109.2826	(39)
Average = Sum(39)m / 12 =												108.3726	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3823	1.3781	1.3740	1.3547	1.3511	1.3342	1.3342	1.3311	1.3407	1.3511	1.3584	1.3660	(40)
HLP (average)												1.3547	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.1315	28.1024	28.9992	25.2822	24.2589	20.9336	19.3980	22.2595	22.5254	26.2511	28.6552	31.1176	(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	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	123.1431	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.5628	17.3755	14.1307	10.6979	7.9968	6.7512	7.2949	9.4822	12.7270	16.1599	18.8609	20.1065	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.4405	221.7177	215.9794	203.7634	188.3429	173.8497	164.1674	161.8903	167.6286	179.8446	195.2651	209.7582	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	35.3143	(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)													
	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	-98.5144	(71)
Water heating gains (Table 5)													
	43.1875	41.8191	38.9774	35.1141	32.6060	29.0744	26.0726	29.9187	31.2852	35.2838	39.7988	41.8248	(72)
Total internal gains													
	342.1338	340.8551	329.0304	309.5183	288.8885	269.6182	257.4779	261.2341	271.5837	291.2311	313.8678	331.6325	(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	7.3500	10.6334	0.6300	0.7000	0.7700	23.8853	(74)
West	10.5100	19.6403	0.6300	0.7000	0.7700	63.0844	(80)

Solar gains	86.9697	169.0525	280.7966	420.9903	531.0835	551.5217	521.7629	437.1805	329.6250	200.7678	108.1244	71.7895	(83)
Total gains	429.1035	509.9076	609.8271	730.5086	819.9721	821.1399	779.2408	698.4147	601.2087	491.9989	421.9922	403.4220	(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	50.2368	50.3900	50.5410	51.2628	51.4002	52.0494	52.0494	52.1714	51.7974	51.4002	51.1231	50.8366	
alpha	4.3491	4.3593	4.3694	4.4175	4.4267	4.4700	4.4700	4.4781	4.4532	4.4267	4.4082	4.3891	
util living area													
	0.9987	0.9969	0.9907	0.9651	0.8882	0.7351	0.5761	0.6514	0.8903	0.9853	0.9974	0.9990	(86)
MIT	19.4026	19.5723	19.8837	20.3138	20.6864	20.9097	20.9765	20.9604	20.7676	20.2760	19.7676	19.3815	(87)
Th 2	19.7769	19.7801	19.7833	19.7983	19.8011	19.8141	19.8141	19.8166	19.8091	19.8011	19.7954	19.7895	(88)
util rest of house													
	0.9982	0.9958	0.9870	0.9507	0.8415	0.6342	0.4339	0.5071	0.8240	0.9771	0.9962	0.9986	(89)
MIT 2	18.3316	18.5033	18.8153	19.2475	19.5908	19.7735	19.8085	19.8056	19.6764	19.2192	18.7105	18.3202	(90)
Living area fraction									fLA = Living area / (4) =			0.1125	(91)
MIT	18.4521	18.6236	18.9355	19.3675	19.7141	19.9013	19.9399	19.9355	19.7992	19.3381	18.8294	18.4396	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4521	18.6236	18.9355	19.3675	19.7141	19.9013	19.9399	19.9355	19.7992	19.3381	18.8294	18.4396	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9974	0.9942	0.9835	0.9439	0.8374	0.6425	0.4498	0.5229	0.8233	0.9725	0.9949	0.9980	(94)
Useful gains	427.9820	506.9489	599.7647	689.5130	686.6197	527.5487	350.5399	365.1956	494.9943	478.4642	419.8271	402.6231	(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													
	1565.0442	1513.0425	1366.9328	1134.4019	866.1975	565.8431	356.4885	376.4827	611.2710	944.4535	1274.6396	1556.1426	(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													
	845.9742	676.0949	570.7731	320.3200	133.6059	0.0000	0.0000	0.0000	0.0000	346.6961	615.4650	858.2185	(98)
Space heating												4367.1476	(98)
Space heating per m2											(98) / (4) =	54.5893	(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	1003.3211	789.8485	809.2985	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8358	0.8992	0.8611	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	838.6112	710.2284	696.8472	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1051.5626	1000.6859	907.7391	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	153.3250	216.1004	156.9035	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												526.3289	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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   38.3313   54.0251   39.2259    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          131.5822 (107)
Space cooling per m2                                                                                                     1.6448 (108)
Energy for space heating                                                                                                54.5893 (99)
Energy for space cooling                                                                                                 1.6448 (108)
Total                                                                                                                   56.2341 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                     64.7 (109)


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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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000	(1b)	x 2.5400	(2b) =	101.6000	(1b) - (3b)
First floor	40.0000	(1c)	x 2.6300	(2c) =	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1934	(8)
Pressure test		Yes	
Measured/design AP50		4.4600	
Infiltration rate		0.4164	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4164	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4372	0.4060	0.4164	0.3956	0.3956	0.3852	0.3748	0.3644	0.3540	0.3852	0.3644	0.3852	(22b)
Effective ac	0.5956	0.5824	0.5867	0.5783	0.5783	0.5742	0.5702	0.5664	0.5626	0.5742	0.5664	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11908.2940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.8537 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.0557 (36)
Total fabric heat loss	(33) + (36) =	72.2872 (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	40.6455	39.7469	40.0390	39.4621	39.4621	39.1848	38.9148	38.6522	38.3971	39.1848	38.6522	39.1848	(38)
Heat transfer coeff	112.9328	112.0341	112.3263	111.7493	111.7493	111.4720	111.2020	110.9395	110.6843	111.4720	110.9395	111.4720	(39)

Average = Sum(39)m / 12 = 111.5811 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4117	1.4004	1.4041	1.3969	1.3969	1.3934	1.3900	1.3867	1.3836	1.3934	1.3867	1.3934	(40)
HLP (average)												1.3948	(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	2.4629 (42)
Average daily hot water use (litres/day)	92.6930 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
               22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
              165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (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
              165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   1623.6559 (64)
RHI water heating demand                                                                                                                    1624 (64)
Heat gains from water heating, kWh/month
               53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               48.8998    43.4323    35.3215    26.7407    19.9890    16.8755    18.2346    23.7020    31.8128    40.3937    47.1454    50.2588 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              327.5232   330.9219   322.3573   304.1245   281.1088   259.4772   245.0260   241.6274   250.1919   268.4248   291.4405   313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400 (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)
              -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
               72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
              553.2404   549.0245   527.8908   495.0183   461.3165   431.0338   413.2377   421.3367   440.1569   473.2411   510.0895   538.0122 (73)
```

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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                                  7.4300            13.4839           0.4600             0.0000           0.7700           35.4856 (74)
West                                   7.3000            25.1925           0.4600             0.0000           0.7700           65.1393 (80)
West                                   3.3300            25.1925           0.4600             0.0000           0.7700           29.7142 (80)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    130.3392   216.2263   362.6550   546.4024   653.5324   736.1947   691.4479   595.0110   449.5647   277.3165   161.6642   105.6581 (83)
Total gains    683.5796   765.2508   890.5458  1041.4207  1114.8488  1167.2285  1104.6856  1016.3477   889.7215   750.5576   671.7537   643.6703 (84)
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7. Mean internal temperature (heating season)

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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            29.2905    29.5255    29.4487    29.6007    29.6007    29.6744    29.7464    29.8168    29.8855    29.6744    29.8168    29.6744
alpha           2.9527     2.9684     2.9632     2.9734     2.9734     2.9783     2.9831     2.9878     2.9924     2.9783     2.9878     2.9783
util living area
                0.9645     0.9504     0.9101     0.8208     0.6857     0.4999     0.3776     0.4060     0.6523     0.8627     0.9438     0.9687 (86)

MIT            19.1307    19.3313    19.7685    20.3033    20.6997    20.9158    20.9731    20.9675    20.8101    20.3152    19.6702    19.1204 (87)
Th 2           19.7544    19.7630    19.7602    19.7657    19.7657    19.7684    19.7710    19.7735    19.7760    19.7684    19.7735    19.7684 (88)
util rest of house
                0.9569     0.9400     0.8910     0.7833     0.6207     0.4067     0.2649     0.2866     0.5615     0.8234     0.9297     0.9619 (89)
MIT 2          17.3367    17.6285    18.2459    18.9798    19.4812    19.7129    19.7607    19.7608    19.6279    19.0211    18.1267    17.3308 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1125 (91)
MIT            17.5385    17.8200    18.4172    19.1287    19.6183    19.8482    19.8971    19.8966    19.7609    19.1667    18.3004    17.5322 (92)
Temperature adjustment                                                                                                             -0.1500
adjusted MIT   17.3885    17.6700    18.2672    18.9787    19.4683    19.6982    19.7471    19.7466    19.6109    19.0167    18.1504    17.3822 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9356     0.9151     0.8609     0.7546     0.6031     0.4010     0.2627     0.2838     0.5477     0.7928     0.9032     0.9422 (94)
Useful gains  639.5591   700.3075   766.6309   785.8935   672.3716   468.1014   290.1611   288.4619   487.2830   595.0061   606.7478   606.4630 (95)
Ext temp.       4.9000     5.3000     7.0000     9.5000    12.5000    15.3000    17.1000    17.1000    14.7000    11.4000     7.9000     5.0000 (96)
Heat loss rate W
             1410.3610  1385.8650  1265.5990  1059.2362   778.7037   490.2771   294.3605   293.6090   543.5545   849.0505  1137.1694  1380.2629 (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
              573.4766   460.6947   371.2323   196.8068    79.1111     0.0000     0.0000     0.0000     0.0000   189.0090   381.9036   575.7071 (98)
Space heating                                                                                                                     2827.9412 (98)
RHI space heating demand                                                                                                             2828 (98)
```

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000	(1b)	x 2.5400	(2b) =	101.6000	(1b) - (3b)
First floor	40.0000	(1c)	x 2.6300	(2c) =	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1934	(8)
Pressure test		Yes	
Measured/design AP50		4.4600	
Infiltration rate		0.4164	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4164	(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	0.5309	0.5205	0.5101	0.4581	0.4477	0.3956	0.3956	0.3852	0.4164	0.4477	0.4685	0.4893	(22b)
Effective ac	0.6409	0.6355	0.6301	0.6049	0.6002	0.5783	0.5783	0.5742	0.5867	0.6002	0.6097	0.6197	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		11908.2940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.8537	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0557	(36)
Total fabric heat loss					(33) + (36) =		72.2872	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.7409	43.3674	43.0013	41.2816	40.9599	39.4621	39.4621	39.1848	40.0390	40.9599	41.6108	42.2912	(38)
Heat transfer coeff	116.0281	115.6546	115.2885	113.5688	113.2471	111.7493	111.7493	111.4720	112.3263	113.2471	113.8980	114.5784	(39)
Average = Sum(39)m / 12 =												113.5673	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4504	1.4457	1.4411	1.4196	1.4156	1.3969	1.3969	1.3934	1.4041	1.4156	1.4237	1.4322	(40)
HLP (average)												1.4196	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
              165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (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
              165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1623.6559 (64)
Heat gains from water heating, kWh/month
              53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (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        147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               48.8998    43.4323    35.3215    26.7407    19.9890    16.8755    18.2346    23.7020    31.8128    40.3937    47.1454    50.2588 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              327.5232   330.9219   322.3573   304.1245   281.1088   259.4772   245.0260   241.6274   250.1919   268.4248   291.4405   313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400 (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)
              -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
               72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
              553.2404   549.0245   527.8908   495.0183   461.3165   431.0338   413.2377   421.3367   440.1569   473.2411   510.0895   538.0122 (73)


-------------------------------------------------------------------------------------------------------------------
6. Solar gains
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[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                                   7.4300          10.6334          0.4600         0.0000          0.7700         27.9840 (74)
West                                    7.3000          19.6403          0.4600         0.0000          0.7700         50.7830 (80)
West                                    3.3300          19.6403          0.4600         0.0000          0.7700         23.1654 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains   101.9324   198.1377   329.1061   493.4142   622.4404   646.3909   611.5146   512.3873   386.3338   235.3095   126.7269    84.1404 (83)
Total gains   655.1728   747.1622   856.9969   988.4324  1083.7568  1077.4247  1024.7524   933.7240   826.4906   708.5506   636.8163   622.1526 (84)


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7. Mean internal temperature (heating season)
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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          28.5091    28.6012    28.6920    29.1265    29.2092    29.6007    29.6007    29.6744    29.4487    29.2092    29.0423    28.8698
alpha         2.9006     2.9067     2.9128     2.9418     2.9473     2.9734     2.9734     2.9783     2.9632     2.9473     2.9362     2.9247
util living area
               0.9711     0.9567     0.9249     0.8536     0.7359     0.5817     0.4501     0.5034     0.7232     0.8970     0.9576     0.9748 (86)

MIT           18.9209    19.1651    19.5925    20.1460    20.5880    20.8568    20.9507    20.9308    20.7134    20.1264    19.4347    18.8843 (87)
Th 2          19.7249    19.7285    19.7320    19.7483    19.7514    19.7657    19.7657    19.7684    19.7602    19.7514    19.7452    19.7387 (88)
util rest of house
               0.9649     0.9475     0.9087     0.8218     0.6791     0.4933     0.3355     0.3857     0.6431     0.8673     0.9471     0.9695 (89)
MIT 2         17.0166    17.3695    17.9808    18.7587    19.3363    19.6573    19.7421    19.7321    19.5133    18.7558    17.7734    16.9718 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1125 (91)
MIT           17.2308    17.5715    18.1621    18.9148    19.4771    19.7922    19.8781    19.8669    19.6483    18.9100    17.9603    17.1869 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT  17.0808    17.4215    18.0121    18.7648    19.3271    19.6422    19.7281    19.7169    19.4983    18.7600    17.8103    17.0369 (93)


-------------------------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9455     0.9235     0.8791     0.7910     0.6569     0.4837     0.3318     0.3804     0.6233     0.8358     0.9232     0.9518 (94)
Useful gains 619.4925   690.0231   753.3591   781.8361   711.9126   521.1281   340.0230   355.2326   515.1256   592.2283   587.8928   592.1386 (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
            1482.9356  1448.1747  1327.2165  1120.3311   863.7525   563.4652   349.5637   369.7461   606.3733   924.0926  1219.8839  1470.8363 (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
              642.4017   509.4779   426.9500   243.7164   112.9689     0.0000     0.0000     0.0000     0.0000   246.9070   455.0336   653.7511 (98)
Space heating                                                                                                                  3291.2065 (98)
Space heating per m2                                                                                                 (98) / (4) =     41.1401 (99)


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8c. Space cooling requirement
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3636.6923	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	642.4017	509.4779	426.9500	243.7164	112.9689	0.0000	0.0000	0.0000	0.0000	246.9070	455.0336	653.7511	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	709.8361	562.9590	471.7679	269.2999	124.8275	0.0000	0.0000	0.0000	0.0000	272.8255	502.7996	722.3769	(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													
	165.3265	144.9838	150.5329	132.5472	128.1546	112.0209	105.2241	118.7262	119.5455	137.5716	148.4786	160.5440	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8261	89.7710	89.6435	89.3463	88.7706	87.3000	87.3000	87.3000	87.3000	89.3284	89.6912	89.8507	(217)
Fuel for water heating, kWh/month													
	184.0518	161.5040	167.9241	148.3522	144.3661	128.3171	120.5316	135.9979	136.9365	154.0066	165.5443	178.6787	(219)
Water heating fuel used												1826.2108	(219)
Annual totals kWh/year													
Space heating fuel - main system												3636.6923	(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)												345.4340	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) =										-1264.5955		-1264.5955	(233)
Total delivered energy for all uses												4618.7416	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3636.6923	3.4800	126.5569	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.2108	3.4800	63.5521	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	345.4340	13.1900	45.5627	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1264.5955	13.1900	-166.8001	(252)
Total energy cost			198.7641	(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] =	0.6678	(257)
SAP value		90.6835	
SAP rating (Section 12)		91	(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	3636.6923	0.2160	785.5255	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.2108	0.2160	394.4615	(264)
Space and water heating			1179.9871	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	345.4340	0.5190	179.2802	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total kg/year			741.8673	(272)
CO2 emissions per m2			9.2700	(273)
EI value			92.0472	
EI rating			92	(274)
EI band			A	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8879 = 3.920, stars = 4
Water heating environmental impact	0.216 / 0.8879 = 0.2433, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000	(1b)	x 2.5400	(2b) =	101.6000	(1b) - (3b)
First floor	40.0000	(1c)	x 2.6300	(2c) =	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1934	(8)
Pressure test		Yes	
Measured/design AP50		4.4600	
Infiltration rate		0.4164	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4164	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4372	0.4060	0.4164	0.3956	0.3956	0.3852	0.3748	0.3644	0.3540	0.3852	0.3644	0.3852	(22b)
Effective ac	0.5956	0.5824	0.5867	0.5783	0.5783	0.5742	0.5702	0.5664	0.5626	0.5742	0.5664	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		11908.2940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.8537	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0557	(36)
Total fabric heat loss					(33) + (36) =		72.2872	(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	40.6455	39.7469	40.0390	39.4621	39.4621	39.1848	38.9148	38.6522	38.3971	39.1848	38.6522	39.1848	(38)
Heat transfer coeff	112.9328	112.0341	112.3263	111.7493	111.7493	111.4720	111.2020	110.9395	110.6843	111.4720	110.9395	111.4720	(39)
Average = Sum(39)m / 12 =												111.5811	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4117	1.4004	1.4041	1.3969	1.3969	1.3934	1.3900	1.3867	1.3836	1.3934	1.3867	1.3934	(40)
HLP (average)												1.3948	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

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

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Distribution loss  (46)m = 0.15 x (45)m
              22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
             165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (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
             165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1623.6559 (64)
Heat gains from water heating, kWh/month
              53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (65)


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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        147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              48.8998    43.4323    35.3215    26.7407    19.9890    16.8755    18.2346    23.7020    31.8128    40.3937    47.1454    50.2588 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             327.5232   330.9219   322.3573   304.1245   281.1088   259.4772   245.0260   241.6274   250.1919   268.4248   291.4405   313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400 (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)
             -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
              72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
             553.2404   549.0245   527.8908   495.0183   461.3165   431.0338   413.2377   421.3367   440.1569   473.2411   510.0895   538.0122 (73)


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6. Solar gains
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[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                                   7.4300           13.4839          0.4600          0.0000          0.7700          35.4856 (74)
West                                    7.3000           25.1925          0.4600          0.0000          0.7700          65.1393 (80)
West                                    3.3300           25.1925          0.4600          0.0000          0.7700          29.7142 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains    130.3392   216.2263   362.6550   546.4024   653.5324   736.1947   691.4479   595.0110   449.5647   277.3165   161.6642   105.6581 (83)
Total gains    683.5796   765.2508   890.5458  1041.4207  1114.8488  1167.2285  1104.6856  1016.3477   889.7215   750.5576   671.7537   643.6703 (84)


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7. Mean internal temperature (heating season)
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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          29.2905    29.5255    29.4487    29.6007    29.6007    29.6744    29.7464    29.8168    29.8855    29.6744    29.8168    29.6744
alpha         2.9527     2.9684     2.9632     2.9734     2.9734     2.9783     2.9831     2.9878     2.9924     2.9783     2.9878     2.9783
util living area
               0.9645     0.9504     0.9101     0.8208     0.6857     0.4999     0.3776     0.4060     0.6523     0.8627     0.9438     0.9687 (86)

MIT           19.1307    19.3313    19.7685    20.3033    20.6997    20.9158    20.9731    20.9675    20.8101    20.3152    19.6702    19.1204 (87)
Th 2          19.7544    19.7630    19.7602    19.7657    19.7657    19.7684    19.7710    19.7735    19.7760    19.7684    19.7735    19.7684 (88)
util rest of house
               0.9569     0.9400     0.8910     0.7833     0.6207     0.4067     0.2649     0.2866     0.5615     0.8234     0.9297     0.9619 (89)
MIT 2         17.3367    17.6285    18.2459    18.9798    19.4812    19.7129    19.7607    19.7608    19.6279    19.0211    18.1267    17.3308 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1125 (91)
MIT           17.5385    17.8200    18.4172    19.1287    19.6183    19.8482    19.8971    19.8966    19.7609    19.1667    18.3004    17.5322 (92)
Temperature adjustment                                                                                                        -0.1500
adjusted MIT  17.3885    17.6700    18.2672    18.9787    19.4683    19.6982    19.7471    19.7466    19.6109    19.0167    18.1504    17.3822 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9356     0.9151     0.8609     0.7546     0.6031     0.4010     0.2627     0.2838     0.5477     0.7928     0.9032     0.9422 (94)
Useful gains 639.5591   700.3075   766.6309   785.8935   672.3716   468.1014   290.1611   288.4619   487.2830   595.0061   606.7478   606.4630 (95)
Ext temp.      4.9000     5.3000     7.0000     9.5000    12.5000    15.3000    17.1000    17.1000    14.7000    11.4000     7.9000     5.0000 (96)
Heat loss rate W
            1410.3610  1385.8650  1265.5990  1059.2362   778.7037   490.2771   294.3605   293.6090   543.5545   849.0505  1137.1694  1380.2629 (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
             573.4766   460.6947   371.2323   196.8068    79.1111     0.0000     0.0000     0.0000     0.0000   189.0090   381.9036   575.7071 (98)
Space heating                                                                                                              2827.9412 (98)
Space heating per m2                                                                                          (98) / (4) =     35.3493 (99)


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8c. Space cooling requirement
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3124.7969	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	573.4766	460.6947	371.2323	196.8068	79.1111	0.0000	0.0000	0.0000	0.0000	189.0090	381.9036	575.7071	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	633.6758	509.0549	410.2014	217.4661	87.4156	0.0000	0.0000	0.0000	0.0000	208.8497	421.9929	636.1405	(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													
	165.3265	144.9838	150.5329	132.5472	128.1546	112.0209	105.2241	118.7262	119.5455	137.5716	148.4786	160.5440	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7637	89.7128	89.5530	89.1844	88.4943	87.3000	87.3000	87.3000	87.3000	89.1238	89.5808	89.7824	(217)
Fuel for water heating, kWh/month													
	184.1797	161.6088	168.0938	148.6215	144.8167	128.3171	120.5316	135.9979	136.9365	154.3600	165.7483	178.8146	(219)
Water heating fuel used												1828.0265	(219)
Annual totals kWh/year													
Space heating fuel - main system												3124.7969	(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)												345.4340	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1187 * 1.00) =										-1404.8611		-1404.8611	(233)
Total delivered energy for all uses												3968.3963	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3124.7969	10.2300	319.6667	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.0265	10.2300	187.0071	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	345.4340	36.7200	126.8434	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1404.8611	36.7200	-515.8650	(252)
Total energy cost			248.1922	(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	3124.7969	0.2160	674.9561	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.0265	0.2160	394.8537	(264)
Space and water heating			1069.8099	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	345.4340	0.5190	179.2802	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	0.5190	-729.1229	(269)
Total kg/year			558.8922	(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	3124.7969	1.2200	3812.2523	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.0265	1.2200	2230.1924	(264)
Space and water heating			6042.4446	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	345.4340	3.0700	1060.4823	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	3.0700	-4312.9235	(269)
Primary energy kWh/year			3020.2534	(272)
Primary energy kWh/m2/year			37.7532	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (33.0%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£81	2.31 kg/m²	A 92	A 94
	Total Savings	£81	2.31 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£154	£173	-£18
Mains gas	£610	£510	£100
Space heating	£450	£450	£0
Water heating	£187	£106	£81
Lighting	£127	£127	£0
Generated (PV)	-£516	-£516	£0
Total cost of fuels	£248	£167	£82
Total cost of uses	£248	£167	£81
Delivered energy	50 kWh/m²	38 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	38 kWh/m²	25 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000	(1b)	x 2.5400	(2b) =	101.6000	(1b) - (3b)
First floor	40.0000	(1c)	x 2.6300	(2c) =	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1934	(8)
Pressure test		Yes	
Measured/design AP50		4.4600	
Infiltration rate		0.4164	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4164	(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	0.5309	0.5205	0.5101	0.4581	0.4477	0.3956	0.3956	0.3852	0.4164	0.4477	0.4685	0.4893	(22b)
Effective ac	0.6409	0.6355	0.6301	0.6049	0.6002	0.5783	0.5783	0.5742	0.5867	0.6002	0.6097	0.6197	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		11908.2940	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.8537	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0557	(36)
Total fabric heat loss					(33) + (36) =		72.2872	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.7409	43.3674	43.0013	41.2816	40.9599	39.4621	39.4621	39.1848	40.0390	40.9599	41.6108	42.2912	(38)
Heat transfer coeff	116.0281	115.6546	115.2885	113.5688	113.2471	111.7493	111.7493	111.4720	112.3263	113.2471	113.8980	114.5784	(39)
Average = Sum(39)m / 12 =												113.5673	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4504	1.4457	1.4411	1.4196	1.4156	1.3969	1.3969	1.3934	1.4041	1.4156	1.4237	1.4322	(40)
HLP (average)												1.4196	(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	2.4629	(42)
Average daily hot water use (litres/day)	92.6930	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
              165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (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                                                                                                                     1.2435 (H8)
Utilisation factor                                                                                                                      0.5525 (H9)
Collector performance factor                                                                                                            0.8793 (H10)
Dedicated solar storage volume                                                                                                         75.0000 (H11)
Effective solar volume                                                                                                                 75.0000 (H13)
Daily hot water demand                                                                                                                 92.6930 (H14)
Volume ratio Veff/V                                                                                                                     0.8091 (H15)
Solar storage volume factor                                                                                                             0.9576 (H16)
Solar input                                                                                                                          -843.7961 (H17)
Solar input    -24.4684   -40.8307   -69.5394   -93.1965  -115.1365  -113.1975  -111.7015   -97.5942   -76.4358   -52.1967   -29.0231   -20.4759 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =   -843.7961 (63)
Output from w/h
              140.8581   104.1531    80.9935    39.3506    13.0182     0.0000     0.0000    21.1320    43.1097    85.3749   119.4555   140.0681 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =    787.5138 (64)
Heat gains from water heating, kWh/month
              53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               48.8998    43.4323    35.3215    26.7407    19.9890    16.8755    18.2346    23.7020    31.8128    40.3937    47.1454    50.2588 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              327.5232   330.9219   322.3573   304.1245   281.1088   259.4772   245.0260   241.6274   250.1919   268.4248   291.4405   313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400 (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)
              -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
               72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
              553.2404   549.0245   527.8908   495.0183   461.3165   431.0338   413.2377   421.3367   440.1569   473.2411   510.0895   538.0122 (73)
```

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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	7.4300	10.6334	0.4600	0.0000	0.7700	27.9840	(74)
West	7.3000	19.6403	0.4600	0.0000	0.7700	50.7830	(80)
West	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(80)

```
Solar gains    101.9324   198.1377   329.1061   493.4142   622.4404   646.3909   611.5146   512.3873   386.3338   235.3095   126.7269    84.1404 (83)
Total gains    655.1728   747.1622   856.9969   988.4324  1083.7568  1077.4247  1024.7524   933.7240   826.4906   708.5506   636.8163   622.1526 (84)
```

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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           28.5091    28.6012    28.6920    29.1265    29.2092    29.6007    29.6007    29.6744    29.4487    29.2092    29.0423    28.8698
alpha          2.9006     2.9067     2.9128     2.9418     2.9473     2.9734     2.9734     2.9783     2.9632     2.9473     2.9362     2.9247
util living area
               0.9711     0.9567     0.9249     0.8536     0.7359     0.5817     0.4501     0.5034     0.7232     0.8970     0.9576     0.9748 (86)

MIT           18.9209    19.1651    19.5925    20.1460    20.5880    20.8568    20.9507    20.9308    20.7134    20.1264    19.4347    18.8843 (87)
Th 2          19.7249    19.7285    19.7320    19.7483    19.7514    19.7657    19.7657    19.7684    19.7602    19.7514    19.7452    19.7387 (88)
util rest of house
               0.9649     0.9475     0.9087     0.8218     0.6791     0.4933     0.3355     0.3857     0.6431     0.8673     0.9471     0.9695 (89)
MIT 2         17.0166    17.3695    17.9808    18.7587    19.3363    19.6573    19.7421    19.7321    19.5133    18.7558    17.7734    16.9718 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1125 (91)
MIT           17.2308    17.5715    18.1621    18.9148    19.4771    19.7922    19.8781    19.8669    19.6483    18.9100    17.9603    17.1869 (92)
Temperature adjustment                                                                                                              -0.1500
adjusted MIT  17.0808    17.4215    18.0121    18.7648    19.3271    19.6422    19.7281    19.7169    19.4983    18.7600    17.8103    17.0369 (93)
```

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	0.9455	0.9235	0.8791	0.7910	0.6569	0.4837	0.3318	0.3804	0.6233	0.8358	0.9232	0.9518	(94)
Useful gains	619.4925	690.0231	753.3591	781.8361	711.9126	521.1281	340.0230	355.2326	515.1256	592.2283	587.8928	592.1386	(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	1482.9356	1448.1747	1327.2165	1120.3311	863.7525	563.4652	349.5637	369.7461	606.3733	924.0926	1219.8839	1470.8363	(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	642.4017	509.4779	426.9500	243.7164	112.9689	0.0000	0.0000	0.0000	0.0000	246.9070	455.0336	653.7511	(98)
Space heating												3291.2065	(98)
Space heating per m2											(98) / (4) =	41.1401	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3636.6923	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	642.4017	509.4779	426.9500	243.7164	112.9689	0.0000	0.0000	0.0000	0.0000	246.9070	455.0336	653.7511	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	709.8361	562.9590	471.7679	269.2999	124.8275	0.0000	0.0000	0.0000	0.0000	272.8255	502.7996	722.3769	(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	140.8581	104.1531	80.9935	39.3506	13.0182	0.0000	0.0000	21.1320	43.1097	85.3749	119.4555	140.0681	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9073	89.9404	89.9741	90.0412	90.1585	87.3000	87.3000	87.3000	87.3000	89.6556	89.8154	89.9184	(217)
Fuel for water heating, kWh/month	156.6703	115.8023	90.0187	43.7029	14.4392	0.0000	0.0000	24.2062	49.3811	95.2254	133.0011	155.7724	(219)
Water heating fuel used												878.2197	(219)

Annual totals kWh/year		
Space heating fuel - main system	3636.6923	(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)	345.4340	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) = -1264.5955	-1264.5955	(233)
Total delivered energy for all uses	3720.7505	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3636.6923	3.4800	126.5569	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.2197	3.4800	30.5620	(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	345.4340	13.1900	45.5627	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1264.5955	13.1900	-166.8001	(252)
Total energy cost			172.3690	(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] =	0.5792	(257)
SAP value	91.9207	
SAP rating (Section 12)	92	(258)
SAP band	A	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3636.6923	0.2160	785.5255	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.2197	0.2160	189.6954	(264)
Space and water heating			975.2210	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	345.4340	0.5190	179.2802	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total kg/year			563.0512	(272)
CO2 emissions per m2			7.0400	(273)
EI value			93.9641	
EI rating			94	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0000	(1b)	x 2.5400	(2b) =	101.6000	(1b) - (3b)
First floor	40.0000	(1c)	x 2.6300	(2c) =	105.2000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =		0.1934	(8)
Pressure test			Yes	
Measured/design AP50			4.4600	
Infiltration rate			0.4164	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4164	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4372	0.4060	0.4164	0.3956	0.3956	0.3852	0.3748	0.3644	0.3540	0.3852	0.3644	0.3852	(22b)
Effective ac	0.5956	0.5824	0.5867	0.5783	0.5783	0.5742	0.5702	0.5664	0.5626	0.5742	0.5664	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			14.7300	1.2357	18.2025			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.0000	0.1200	4.8000	75.0000	3000.0000	(28a)
EW Brick AAC015	135.9700	20.1900	115.7800	0.2500	28.9450	52.3000	6055.2940	(29a)
Plane Ceiling	40.0000		40.0000	0.1600	6.4000	9.0000	360.0000	(30)
Total net area of external elements Aum(A, m2)			215.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.2315			(33)
GF Timber			75.0000			9.0000	675.0000	(32c)
1F Timber			75.0000			9.0000	675.0000	(32c)
Internal Floor			40.0000			18.0000	720.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11908.2940 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		148.8537 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.0557 (36)
Total fabric heat loss	(33) + (36) =	72.2872 (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	40.6455	39.7469	40.0390	39.4621	39.4621	39.1848	38.9148	38.6522	38.3971	39.1848	38.6522	39.1848	(38)
Heat transfer coeff	112.9328	112.0341	112.3263	111.7493	111.7493	111.4720	111.2020	110.9395	110.6843	111.4720	110.9395	111.4720	(39)
Average = Sum(39)m / 12 =												111.5811	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4117	1.4004	1.4041	1.3969	1.3969	1.3934	1.3900	1.3867	1.3836	1.3934	1.3867	1.3934	(40)
HLP (average)												1.3948	(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	2.4629 (42)
Average daily hot water use (litres/day)	92.6930 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9622	98.2545	94.5468	90.8391	87.1314	83.4237	83.4237	87.1314	90.8391	94.5468	98.2545	101.9622	(44)
Energy conte	151.2071	132.2467	136.4667	118.9750	114.1593	98.5108	91.2848	104.7506	106.0017	123.5347	134.8478	146.4360	(45)
Energy content (annual)										Total = Sum(45)m =		1458.4211	(45)

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

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Distribution loss  (46)m = 0.15 x (45)m
              22.6811    19.8370    20.4700    17.8462    17.1239    14.7766    13.6927    15.7126    15.9002    18.5302    20.2272    21.9654 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss    14.1195    12.7371    14.0662    13.5722    13.9953    13.5100    13.9393    13.9756    13.5439    14.0369    13.6308    14.1080 (61)
Total heat required for water heating calculated for each month
             165.3265   144.9838   150.5329   132.5472   128.1546   112.0209   105.2241   118.7262   119.5455   137.5716   148.4786   160.5440 (62)
Aperture area of solar collector                                                                                                      3.0000 (H1)
Zero-loss collector efficiency                                                                                                        0.7000 (H2)
Collector heat loss coefficient                                                                                                       1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                             0.0050 (H3a)
Collector effective heat loss coefficient                                                                                             1.8063 (H3b)
Collector performance ratio                                                                                                           2.5804 (H4)
Annual solar radiation per m2                                                                                                      1208.1510 (H5)
Overshading factor                                                                                                                    0.8000 (H6)
Solar energy available                                                                                                             2029.6937 (H7)
Adjustment factor for showers                                                                                                         1.0000 (H7a)
Solar-to-load ratio                                                                                                                   1.3917 (H8)
Utilisation factor                                                                                                                    0.5125 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               92.6930 (H14)
Volume ratio Veff/V                                                                                                                   0.8091 (H15)
Solar storage volume factor                                                                                                           0.9576 (H16)
Solar input                                                                                                                        -875.9758 (H17)
Solar input   -28.5764   -40.6339   -69.8399   -94.2302  -110.6790  -118.2227  -115.7364  -103.5876   -81.1019   -56.0711   -33.7984   -23.4982 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =        -875.9758 (63)
Output from w/h
             136.7501   104.3499    80.6930    38.3170    17.4756     0.0000     0.0000    15.1386    38.4436    81.5005   114.6802   137.0458 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =         764.3943 (64)
Heat gains from water heating, kWh/month
              53.8062    47.1563    48.8917    42.9522    41.4568    36.1324    33.8370    38.3235    38.6315    44.5845    48.2446    52.2170 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
               Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717   147.7717 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               48.8998    43.4323    35.3215    26.7407    19.9890    16.8755    18.2346    23.7020    31.8128    40.3937    47.1454    50.2588 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              327.5232   330.9219   322.3573   304.1245   281.1088   259.4772   245.0260   241.6274   250.1919   268.4248   291.4405   313.0720 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400    52.2400 (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)
              -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144   -98.5144 (71)
Water heating gains (Table 5)
               72.3202    70.1731    65.7147    59.6559    55.7215    50.1838    45.4799    51.5100    53.6549    59.9254    67.0064    70.1841 (72)
Total internal gains
              553.2404   549.0245   527.8908   495.0183   461.3165   431.0338   413.2377   421.3367   440.1569   473.2411   510.0895   538.0122 (73)


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6. Solar gains
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[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                                  7.4300           13.4839            0.4600         0.0000      0.7700      35.4856 (74)
West                                   7.3000           25.1925            0.4600         0.0000      0.7700      65.1393 (80)
West                                   3.3300           25.1925            0.4600         0.0000      0.7700      29.7142 (80)
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Solar gains   130.3392   216.2263   362.6550   546.4024   653.5324   736.1947   691.4479   595.0110   449.5647   277.3165   161.6642   105.6581 (83)
Total gains   683.5796   765.2508   890.5458  1041.4207  1114.8488  1167.2285  1104.6856  1016.3477   889.7215   750.5576   671.7537   643.6703 (84)


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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         29.2905    29.5255    29.4487    29.6007    29.6007    29.6744    29.7464    29.8168    29.8855    29.6744    29.8168    29.6744
alpha        2.9527     2.9684     2.9632     2.9734     2.9734     2.9783     2.9831     2.9878     2.9924     2.9783     2.9878     2.9783
util living area
               0.9645     0.9504     0.9101     0.8208     0.6857     0.4999     0.3776     0.4060     0.6523     0.8627     0.9438     0.9687 (86)

MIT         19.1307    19.3313    19.7685    20.3033    20.6997    20.9158    20.9731    20.9675    20.8101    20.3152    19.6702    19.1204 (87)
Th 2        19.7544    19.7630    19.7602    19.7657    19.7657    19.7684    19.7710    19.7735    19.7760    19.7684    19.7735    19.7684 (88)
util rest of house
               0.9569     0.9400     0.8910     0.7833     0.6207     0.4067     0.2649     0.2866     0.5615     0.8234     0.9297     0.9619 (89)
MIT 2       17.3367    17.6285    18.2459    18.9798    19.4812    19.7129    19.7607    19.7608    19.6279    19.0211    18.1267    17.3308 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.1125 (91)
MIT         17.5385    17.8200    18.4172    19.1287    19.6183    19.8482    19.8971    19.8966    19.7609    19.1667    18.3004    17.5322 (92)
Temperature adjustment                                                                                                -0.1500
adjusted MIT    17.3885    17.6700    18.2672    18.9787    19.4683    19.6982    19.7471    19.7466    19.6109    19.0167    18.1504    17.3822 (93)


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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	0.9356	0.9151	0.8609	0.7546	0.6031	0.4010	0.2627	0.2838	0.5477	0.7928	0.9032	0.9422	(94)
Useful gains	639.5591	700.3075	766.6309	785.8935	672.3716	468.1014	290.1611	288.4619	487.2830	595.0061	606.7478	606.4630	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1410.3610	1385.8650	1265.5990	1059.2362	778.7037	490.2771	294.3605	293.6090	543.5545	849.0505	1137.1694	1380.2629	(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	573.4766	460.6947	371.2323	196.8068	79.1111	0.0000	0.0000	0.0000	0.0000	189.0090	381.9036	575.7071	(98)
Space heating												2827.9412	(98)
Space heating per m2											(98) / (4) =	35.3493	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3124.7969	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	573.4766	460.6947	371.2323	196.8068	79.1111	0.0000	0.0000	0.0000	0.0000	189.0090	381.9036	575.7071	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	633.6758	509.0549	410.2014	217.4661	87.4156	0.0000	0.0000	0.0000	0.0000	208.8497	421.9929	636.1405	(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													
	136.7501	104.3499	80.6930	38.3170	17.4756	0.0000	0.0000	15.1386	38.4436	81.5005	114.6802	137.0458	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8657	89.8915	89.9115	89.9626	89.9038	87.3000	87.3000	87.3000	87.3000	89.5115	89.7403	89.8666	(217)
Fuel for water heating, kWh/month													
	152.1715	116.0843	89.7472	42.5921	19.4381	0.0000	0.0000	17.3409	44.0362	91.0503	127.7911	152.4991	(219)
Water heating fuel used												852.7508	(219)
Annual totals kWh/year													
Space heating fuel - main system												3124.7969	(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)												345.4340	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1187 * 1.00) =										-1404.8611		-1404.8611	(233)
Total delivered energy for all uses												3043.1207	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3124.7969	10.2300	319.6667	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.7508	10.2300	87.2364	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	345.4340	36.7200	126.8434	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1404.8611	36.7200	-515.8650	(252)
Total energy cost			166.7815	(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	3124.7969	0.2160	674.9561	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7508	0.2160	184.1942	(264)
Space and water heating			859.1503	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	345.4340	0.5190	179.2802	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	0.5190	-729.1229	(269)
Total kg/year			374.1827	(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	3124.7969	1.2200	3812.2523	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.7508	1.2200	1040.3560	(264)
Space and water heating			4852.6083	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	345.4340	3.0700	1060.4823	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	3.0700	-4312.9235	(269)
Primary energy kWh/year			1983.9171	(272)
Primary energy kWh/m2/year			24.7990	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	148.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.98 (P1)
Transmission heat loss coefficient	72.29 (37)
Summer heat loss coefficient	345.26 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
West	0.000	1.000	None

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.4300	87.1704	0.4600	0.0000	0.9000	268.1380
West	7.3000	125.2818	0.4600	0.0000	0.9000	378.6266
West	3.3300	125.2818	0.4600	0.0000	0.9000	172.7160
total:						819.4806

	Jun	Jul	Aug	
Solar gains	887	819	703	(P4)
Internal gains	428	410	418	
Total summer gains	1315	1230	1121	(P5)
Summer gain/loss ratio	3.81	3.56	3.25	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 148.9)	0.96	0.96	0.96	
Threshold temperature	20.17	21.82	21.51	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-570.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-OP-SEMI
Property	24, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	92 A	**DER**	9.18	**TER**	18.50
Environmental	93 A	**% DER<TER**	50.37		
CO_2 Emissions (t/year)	0.43	**DFEE**	45.36	**TFEE**	52.50
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.61		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.50 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.18 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.91 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.06 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 7.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4395	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5183	0.5081	0.4980	0.4471	0.4370	0.3862	0.3862	0.3760	0.4065	0.4370	0.4573	0.4776	(22b)
Effective ac	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1688	42.8138	42.4659	40.8318	40.5260	39.1028	39.1028	38.8392	39.6510	40.5260	41.1446	41.7912	(38)
Heat transfer coeff	99.0504	98.6955	98.3476	96.7134	96.4077	94.9844	94.9844	94.7208	95.5326	96.4077	97.0262	97.6728	(39)
Average = Sum(39)m / 12 =												96.7120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2415	1.2371	1.2327	1.2123	1.2084	1.1906	1.1906	1.1873	1.1975	1.2084	1.2162	1.2243	(40)
HLP (average)												1.2122	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	501.7960	596.0450	682.7893	768.3890	825.3948	812.4274	775.0047	720.1572	657.9433	571.1308	498.0725	471.3869	(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	33.7474	33.8688	33.9886	34.5629	34.6725	35.1920	35.1920	35.2899	34.9901	34.6725	34.4515	34.2234	
alpha	3.2498	3.2579	3.2659	3.3042	3.3115	3.3461	3.3461	3.3527	3.3327	3.3115	3.2968	3.2816	
util living area													
	0.9855	0.9740	0.9508	0.8977	0.7988	0.6486	0.5055	0.5551	0.7699	0.9268	0.9760	0.9880	(86)
MIT	19.0584	19.3096	19.6964	20.1895	20.5993	20.8627	20.9556	20.9389	20.7415	20.2007	19.5463	19.0236	(87)
Th 2	19.8869	19.8904	19.8939	19.9102	19.9133	19.9275	19.9275	19.9302	19.9220	19.9133	19.9071	19.9006	(88)
util rest of house													
	0.9823	0.9685	0.9400	0.8745	0.7519	0.5676	0.3956	0.4446	0.7009	0.9052	0.9700	0.9855	(89)
MIT 2	17.3097	17.6754	18.2339	18.9393	19.4897	19.8160	19.9039	19.8949	19.6863	18.9711	18.0323	17.2675	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6710	18.0130	18.5360	19.1976	19.7189	20.0322	20.1212	20.1106	19.9043	19.2251	18.3451	17.6302	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5210	17.8630	18.3860	19.0476	19.5689	19.8822	19.9712	19.9606	19.7543	19.0751	18.1951	17.4802	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9539	0.9201	0.8515	0.7347	0.5639	0.4003	0.4480	0.6884	0.8831	0.9561	0.9767	(94)
Useful gains	487.8560	568.5455	628.2342	654.2804	606.4024	458.1093	310.2348	322.6277	452.9510	504.3563	476.1875	460.4123	(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													
	1309.5423	1279.3857	1168.9570	981.4064	758.6248	501.7286	320.2091	337.2608	540.1689	817.0656	1076.5111	1297.1174	(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													
	611.3346	477.6846	402.2978	235.5307	113.2535	0.0000	0.0000	0.0000	0.0000	232.6557	432.2330	622.5086	(98)
Space heating												3127.4986	(98)
Space heating per m2											(98) / (4) =	39.2015	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3455.7995	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	611.3346	477.6846	402.2978	235.5307	113.2535	0.0000	0.0000	0.0000	0.0000	232.6557	432.2330	622.5086	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	675.5079	527.8283	444.5279	260.2549	125.1420	0.0000	0.0000	0.0000	0.0000	257.0782	477.6055	687.8549	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7999	89.7347	89.6063	89.3217	88.7733	87.3000	87.3000	87.3000	87.3000	89.2846	89.6603	89.8255	(217)
Fuel for water heating, kWh/month													
	183.9245	161.4105	167.8296	148.2495	144.2230	128.1956	120.4190	135.8687	136.8056	153.9329	165.4391	178.5535	(219)
Water heating fuel used												1824.8514	(219)
Annual totals kWh/year													
Space heating fuel - main system												3455.7995	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4494.0065	(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	3455.7995	0.2160	746.4527	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.8514	0.2160	394.1679	(264)
Space and water heating			1140.6206	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			732.3521	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1800	(273)

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

DER		9.1800	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.6763	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.6763	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(79)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	496.6883	577.4054	649.7721	720.0207	765.5497	750.8193	716.6442	670.7669	619.2540	547.9880	489.0334	468.9134	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9976	0.9946	0.9863	0.9578	0.8778	0.7162	0.5472	0.6020	0.8433	0.9732	0.9950	0.9982	(86)
MIT	19.7307	19.8940	20.1528	20.4915	20.7785	20.9445	20.9884	20.9817	20.8690	20.4959	20.0534	19.7062	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9968	0.9928	0.9813	0.9417	0.8320	0.6242	0.4255	0.4781	0.7704	0.9599	0.9930	0.9976	(89)
MIT 2	18.2444	18.4844	18.8617	19.3529	19.7344	19.9270	19.9597	19.9586	19.8544	19.3683	18.7275	18.2165	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5514	18.7756	19.1284	19.5881	19.9501	20.1372	20.1722	20.1699	20.0640	19.6013	19.0014	18.5243	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9899	0.9762	0.9348	0.8319	0.6408	0.4507	0.5037	0.7788	0.9539	0.9903	0.9964	(94)
Useful gains	494.3401	571.5852	634.2787	673.0433	636.8640	481.1135	323.0045	337.8494	482.2926	522.7404	484.2943	467.2213	(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													
	1349.1222	1309.5523	1188.2896	991.5654	763.3452	505.9492	326.4037	343.6666	547.5953	832.8467	1107.1433	1340.0354	(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													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating												3196.0378	(98)
Space heating per m2											(98) / (4) =	40.0606	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3421.8820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	635.9579	495.9139	412.1841	229.3359	94.1020	0.0000	0.0000	0.0000	0.0000	230.7191	448.4513	649.3737	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	680.8971	530.9570	441.3106	245.5417	100.7516	0.0000	0.0000	0.0000	0.0000	247.0226	480.1406	695.2609	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7397	87.5017	87.0164	85.9015	83.7889	80.3000	80.3000	80.3000	80.3000	85.7982	87.2194	87.8264	(217)
Fuel for water heating, kWh/month													
	230.2308	202.6021	211.9699	190.4467	189.0350	173.7253	166.4421	185.5439	187.5930	199.9232	209.9365	224.5768	(219)
Water heating fuel used												2372.0253	(219)
Annual totals kWh/year													
Space heating fuel - main system												3421.8820	(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)												356.9126	(232)
Total delivered energy for all uses												6225.8200	(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	3421.8820	0.2160	739.1265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2372.0253	0.2160	512.3575	(264)
Space and water heating			1251.4840	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1475.6466	(272)
Emissions per m2 for space and water heating			15.6867	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6867 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5000	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.3910	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3616	(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	0.4611	0.4521	0.4430	0.3978	0.3888	0.3436	0.3436	0.3345	0.3616	0.3888	0.4069	0.4249	(22b)
Effective ac	0.6063	0.6022	0.5981	0.5791	0.5756	0.5590	0.5590	0.5560	0.5654	0.5756	0.5828	0.5903	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(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	41.2629	40.9820	40.7066	39.4132	39.1712	38.0447	38.0447	37.8361	38.4786	39.1712	39.6608	40.1726	(38)
Heat transfer coeff	97.1446	96.8636	96.5883	95.2948	95.0528	93.9263	93.9263	93.7177	94.3602	95.0528	95.5424	96.0542	(39)
Average = Sum(39)m / 12 =												95.2937	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2177	1.2141	1.2107	1.1945	1.1914	1.1773	1.1773	1.1747	1.1828	1.1914	1.1976	1.2040	(40)
HLP (average)												1.1945	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	469.6896	564.7166	653.0758	740.8688	799.2992	788.3357	752.6134	695.5841	632.5928	543.5107	467.8893	440.0531	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4095	34.5093	34.6077	35.0774	35.1667	35.5885	35.5885	35.6677	35.4248	35.1667	34.9865	34.8001	
alpha	3.2940	3.3006	3.3072	3.3385	3.3444	3.3726	3.3726	3.3778	3.3617	3.3444	3.3324	3.3200	
util living area													
	0.9880	0.9774	0.9555	0.9043	0.8070	0.6580	0.5138	0.5664	0.7817	0.9342	0.9798	0.9902	(86)
MIT	19.0486	19.3010	19.6895	20.1812	20.5946	20.8597	20.9547	20.9367	20.7338	20.1844	19.5272	19.0084	(87)
Th 2	19.9059	19.9087	19.9115	19.9244	19.9269	19.9382	19.9382	19.9403	19.9338	19.9269	19.9219	19.9168	(88)
util rest of house													
	0.9854	0.9726	0.9457	0.8823	0.7613	0.5776	0.4036	0.4557	0.7145	0.9145	0.9746	0.9881	(89)
MIT 2	18.1315	18.3834	18.7675	19.2517	19.6326	19.8598	19.9216	19.9150	19.7664	19.2661	18.6195	18.0995	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3210	18.5729	18.9579	19.4437	19.8313	20.0664	20.1350	20.1261	19.9662	19.4558	18.8070	18.2873	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3210	18.5729	18.9579	19.4437	19.8313	20.0664	20.1350	20.1261	19.9662	19.4558	18.8070	18.2873	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9647	0.9347	0.8705	0.7567	0.5881	0.4251	0.4764	0.7169	0.9035	0.9674	0.9837	(94)
Useful gains	460.3659	544.7713	610.4384	644.9207	604.8546	463.6393	319.9456	331.3695	453.4804	491.0860	452.6285	432.8677	(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													
	1362.0630	1324.4084	1203.2914	1004.7578	772.9060	513.4354	332.0282	349.2007	553.5389	841.7694	1118.5181	1353.1430	(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													
	670.8627	523.9161	441.0826	259.0827	125.0302	0.0000	0.0000	0.0000	0.0000	260.9084	479.4405	684.6848	(98)
Space heating												3445.0081	(98)
Space heating per m2											(98) / (4) =	43.1814	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	882.9075	695.0548	712.2546	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8213	0.8799	0.8539	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	725.1294	611.5569	608.1863	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1013.3648	969.7378	904.7039	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	207.5295	266.4865	220.6091	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												694.6251	(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	51.8824	66.6216	55.1523	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												173.6563	(107)
Space cooling per m2												2.1767	(108)
Energy for space heating												43.1814	(99)
Energy for space cooling												2.1767	(108)
Total												45.3580	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.4	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(79)

Solar gains	109.9916	193.1519	279.6728	372.3307	440.5928	447.7661	427.3832	374.8728	311.5114	217.6246	132.8000	93.4470	(83)
Total gains	452.2029	534.0089	608.6129	681.6749	729.2529	717.1489	684.6671	635.9860	583.0680	508.9123	446.7765	425.1967	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9962	0.9895	0.9655	0.8939	0.7395	0.5700	0.6296	0.8666	0.9800	0.9967	0.9989	(86)
MIT	19.6793	19.8444	20.1076	20.4546	20.7548	20.9358	20.9861	20.9777	20.8490	20.4553	20.0049	19.6554	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9979	0.9949	0.9857	0.9519	0.8517	0.6482	0.4445	0.5026	0.7987	0.9696	0.9953	0.9985	(89)
MIT 2	18.7281	18.8950	19.1585	19.5080	19.7849	19.9342	19.9605	19.9597	19.8744	19.5153	19.0664	18.7132	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9246	19.0911	19.3545	19.7035	19.9853	20.1411	20.1723	20.1700	20.0757	19.7095	19.2603	18.9078	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9934	0.9828	0.9479	0.8532	0.6651	0.4707	0.5290	0.8076	0.9664	0.9940	0.9979	(94)
Useful gains	450.9374	530.4905	598.1683	646.1725	622.1983	477.0035	322.2893	336.4477	470.8958	491.8343	444.0959	424.3159	(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													
	1384.4456	1339.3349	1209.5657	1002.2755	766.5973	506.3064	326.4131	343.6723	548.6728	842.8616	1131.2257	1375.9188	(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													
	694.5301	543.5435	454.8797	256.3942	107.4329	0.0000	0.0000	0.0000	0.0000	261.1644	494.7334	707.9925	(98)
Space heating												3520.6706	(98)
Space heating per m2											(98) / (4) =	44.1297	(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	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8659	0.9259	0.9020	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	743.7160	626.0361	624.9430	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	930.1594	890.3200	835.0439	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	134.2393	196.6272	156.3150	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												487.1815	(104)

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	33.5598	49.1568	39.0788	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												121.7954 (107)
Space cooling per m2												1.5266 (108)
Energy for space heating												44.1297 (99)
Energy for space cooling												1.5266 (108)
Total												45.6564 (109)
Target Fabric Energy Efficiency (TFEE)												52.5 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4395	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4268	0.3963	0.4065	0.3862	0.3862	0.3760	0.3658	0.3557	0.3455	0.3760	0.3557	0.3760	(22b)
Effective ac	0.5911	0.5785	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	40.2273	39.3734	39.6510	39.1028	39.1028	38.8392	38.5827	38.3331	38.0907	38.8392	38.3331	38.8392	(38)
Heat transfer coeff	96.1090	95.2550	95.5326	94.9844	94.9844	94.7208	94.4643	94.2148	93.9723	94.7208	94.2148	94.7208	(39)
Average = Sum(39)m / 12 =												94.8245	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2047	1.1940	1.1975	1.1906	1.1906	1.1873	1.1841	1.1809	1.1779	1.1873	1.1809	1.1873	(40)
HLP (average)												1.1886	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (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

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (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)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (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	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(79)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	157.8949	236.5519	347.1161	468.2205	529.1030	585.0786	553.6901	495.9108	409.4920	288.0496	190.1260	131.8038	(83)
Total gains	711.8873	786.1418	875.3256	963.3171	990.3260	1015.9668	966.8627	917.3647	850.0153	761.8973	700.9905	670.6458	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7802	35.0921	34.9901	35.1920	35.1920	35.2899	35.3858	35.4795	35.5711	35.2899	35.4795	35.2899	
alpha	3.3187	3.3395	3.3327	3.3461	3.3461	3.3527	3.3591	3.3653	3.3714	3.3527	3.3653	3.3527	
util living area	0.9575	0.9410	0.8999	0.8157	0.6860	0.4995	0.3717	0.3893	0.6179	0.8331	0.9297	0.9627	(86)
MIT	19.5365	19.7189	20.0690	20.4799	20.7829	20.9449	20.9846	20.9824	20.8862	20.5338	20.0091	19.5228	(87)
Th 2	19.9163	19.9248	19.9220	19.9275	19.9275	19.9302	19.9328	19.9353	19.9377	19.9302	19.9353	19.9302	(88)
util rest of house	0.9490	0.9297	0.8806	0.7805	0.6270	0.4166	0.2741	0.2879	0.5365	0.7923	0.9138	0.9552	(89)
MIT 2	18.0158	18.2806	18.7718	19.3346	19.7173	19.8921	19.9263	19.9278	19.8476	19.4220	18.7061	18.0060	(90)

Living area fraction fLA = Living area / (4) = 0.2066 (91)

MIT	18.3299	18.5777	19.0398	19.5712	19.9374	20.1096	20.1449	20.1457	20.0621	19.6517	18.9753	18.3193	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1799	18.4277	18.8898	19.4212	19.7874	19.9596	19.9949	19.9957	19.9121	19.5017	18.8253	18.1693	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9091	0.8577	0.7614	0.6185	0.4190	0.2799	0.2938	0.5344	0.7730	0.8923	0.9381	(94)
Useful gains	662.5704	714.6424	750.7978	733.4421	612.5376	425.6926	270.6353	269.5621	454.2423	588.9606	625.5016	629.1445	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1276.3211	1250.4773	1135.8605	942.3596	692.1885	441.3607	273.4666	272.8157	489.7956	767.3982	1029.3249	1247.4108	(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	456.6305	360.0811	286.4867	150.4206	59.2603	0.0000	0.0000	0.0000	0.0000	132.7575	290.7528	459.9901	(98)

Space heating 2196.3796 (98)
RHI space heating demand 2196 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4395	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5183	0.5081	0.4980	0.4471	0.4370	0.3862	0.3862	0.3760	0.4065	0.4370	0.4573	0.4776	(22b)
Effective ac	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1688	42.8138	42.4659	40.8318	40.5260	39.1028	39.1028	38.8392	39.6510	40.5260	41.1446	41.7912	(38)
Heat transfer coeff	99.0504	98.6955	98.3476	96.7134	96.4077	94.9844	94.9844	94.7208	95.5326	96.4077	97.0262	97.6728	(39)
Average = Sum(39)m / 12 =												96.7120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2415	1.2371	1.2327	1.2123	1.2084	1.1906	1.1906	1.1873	1.1975	1.2084	1.2162	1.2243	(40)
HLP (average)												1.2122	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	681.4708	773.4495	852.3453	926.6212	971.8621	949.8411	908.5021	855.9248	801.5595	726.0707	664.7774	647.1454	(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	33.7474	33.8688	33.9886	34.5629	34.6725	35.1920	35.1920	35.2899	34.9901	34.6725	34.4515	34.2234	
alpha	3.2498	3.2579	3.2659	3.3042	3.3115	3.3461	3.3461	3.3527	3.3327	3.3115	3.2968	3.2816	
util living area													
	0.9663	0.9484	0.9157	0.8481	0.7362	0.5796	0.4409	0.4816	0.6892	0.8739	0.9483	0.9709	(86)
MIT	19.3330	19.5661	19.9167	20.3516	20.6942	20.9026	20.9705	20.9601	20.8192	20.3783	19.7895	19.2970	(87)
Th 2	19.8869	19.8904	19.8939	19.9102	19.9133	19.9275	19.9275	19.9302	19.9220	19.9133	19.9071	19.9006	(88)
util rest of house													
	0.9596	0.9384	0.8991	0.8179	0.6842	0.5004	0.3412	0.3803	0.6148	0.8421	0.9365	0.9651	(89)
MIT 2	17.7045	18.0402	18.5398	19.1518	19.5994	19.8511	19.9124	19.9081	19.7648	19.2047	18.3766	17.6616	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0409	18.3554	18.8242	19.3996	19.8256	20.0683	20.1310	20.1254	19.9826	19.4472	18.6684	17.9994	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8909	18.2054	18.6742	19.2496	19.6756	19.9183	19.9810	19.9754	19.8326	19.2972	18.5184	17.8494	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9181	0.8759	0.7964	0.6715	0.4997	0.3464	0.3848	0.6080	0.8200	0.9164	0.9497	(94)
Useful gains	642.4862	710.1377	746.5906	737.9250	652.6291	474.6031	314.6726	329.3618	487.3273	595.3704	609.2252	614.5949	(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													
	1346.1862	1313.1803	1197.3051	1000.9490	768.9057	505.1596	321.1414	338.6687	547.6511	838.4741	1107.8874	1333.1746	(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													
	523.5528	405.2446	335.3316	189.3773	86.5098	0.0000	0.0000	0.0000	0.0000	180.8691	359.0368	534.6233	(98)
Space heating												2614.5453	(98)
Space heating per m2											(98) / (4) =	32.7719	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2889.0003	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	523.5528	405.2446	335.3316	189.3773	86.5098	0.0000	0.0000	0.0000	0.0000	180.8691	359.0368	534.6233	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	578.5114	447.7841	370.5322	209.2566	95.5909	0.0000	0.0000	0.0000	0.0000	199.8554	396.7257	590.7440	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7114	89.6349	89.4844	89.1552	88.5627	87.3000	87.3000	87.3000	87.3000	89.0900	89.5404	89.7409	(217)
Fuel for water heating, kWh/month													
	184.1058	161.5903	168.0581	148.5263	144.5660	128.1956	120.4190	135.8687	136.8056	154.2692	165.6606	178.7217	(219)
Water heating fuel used												1826.7869	(219)
Annual totals kWh/year													
Space heating fuel - main system												2889.0003	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3929.1428	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2889.0003	3.4800	100.5372	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.7869	3.4800	63.5722	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			180.3510	(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] =	0.6070	(257)
SAP value		91.5317	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	2889.0003	0.2160	624.0241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7869	0.2160	394.5860	(264)
Space and water heating			1018.6100	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			610.3416	(272)
CO2 emissions per m2			7.6500	(273)
EI value			93.4456	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4395	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4268	0.3963	0.4065	0.3862	0.3862	0.3760	0.3658	0.3557	0.3455	0.3760	0.3557	0.3760	(22b)
Effective ac	0.5911	0.5785	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (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	40.2273	39.3734	39.6510	39.1028	39.1028	38.8392	38.5827	38.3331	38.0907	38.8392	38.3331	38.8392	(38)
Heat transfer coeff	96.1090	95.2550	95.5326	94.9844	94.9844	94.7208	94.4643	94.2148	93.9723	94.7208	94.2148	94.7208	(39)
Average = Sum(39)m / 12 =												94.8245	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2047	1.1940	1.1975	1.1906	1.1906	1.1873	1.1841	1.1809	1.1779	1.1873	1.1809	1.1873	(40)
HLP (average)												1.1886	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(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	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(79)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	157.8949	236.5519	347.1161	468.2205	529.1030	585.0786	553.6901	495.9108	409.4920	288.0496	190.1260	131.8038	(83)
Total gains	711.8873	786.1418	875.3256	963.3171	990.3260	1015.9668	966.8627	917.3647	850.0153	761.8973	700.9905	670.6458	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7802	35.0921	34.9901	35.1920	35.1920	35.2899	35.3858	35.4795	35.5711	35.2899	35.4795	35.2899	
alpha	3.3187	3.3395	3.3327	3.3461	3.3461	3.3527	3.3591	3.3653	3.3714	3.3527	3.3653	3.3527	
util living area													
	0.9575	0.9410	0.8999	0.8157	0.6860	0.4995	0.3717	0.3893	0.6179	0.8331	0.9297	0.9627	(86)
MIT	19.5365	19.7189	20.0690	20.4799	20.7829	20.9449	20.9846	20.9824	20.8862	20.5338	20.0091	19.5228	(87)
Th 2	19.9163	19.9248	19.9220	19.9275	19.9275	19.9302	19.9328	19.9353	19.9377	19.9302	19.9353	19.9302	(88)
util rest of house													
	0.9490	0.9297	0.8806	0.7805	0.6270	0.4166	0.2741	0.2879	0.5365	0.7923	0.9138	0.9552	(89)
MIT 2	18.0158	18.2806	18.7718	19.3346	19.7173	19.8921	19.9263	19.9278	19.8476	19.4220	18.7061	18.0060	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3299	18.5777	19.0398	19.5712	19.9374	20.1096	20.1449	20.1457	20.0621	19.6517	18.9753	18.3193	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1799	18.4277	18.8898	19.4212	19.7874	19.9596	19.9949	19.9957	19.9121	19.5017	18.8253	18.1693	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9091	0.8577	0.7614	0.6185	0.4190	0.2799	0.2938	0.5344	0.7730	0.8923	0.9381	(94)
Useful gains	662.5704	714.6424	750.7978	733.4421	612.5376	425.6926	270.6353	269.5621	454.2423	588.9606	625.5016	629.1445	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1276.3211	1250.4773	1135.8605	942.3596	692.1885	441.3607	273.4666	272.8157	489.7956	767.3982	1029.3249	1247.4108	(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													
	456.6305	360.0811	286.4867	150.4206	59.2603	0.0000	0.0000	0.0000	0.0000	132.7575	290.7528	459.9901	(98)
Space heating												2196.3796	(98)
Space heating per m2											(98) / (4) =	27.5305	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2426.9387	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	456.6305	360.0811	286.4867	150.4206	59.2603	0.0000	0.0000	0.0000	0.0000	132.7575	290.7528	459.9901	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	504.5641	397.8797	316.5599	166.2106	65.4810	0.0000	0.0000	0.0000	0.0000	146.6934	321.2738	508.2764	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6273	89.5583	89.3723	88.9731	88.2877	87.3000	87.3000	87.3000	87.3000	88.8435	89.3930	89.6504	(217)
Fuel for water heating, kWh/month													
	184.2785	161.7284	168.2690	148.8303	145.0163	128.1956	120.4190	135.8687	136.8056	154.6972	165.9337	178.9021	(219)
Water heating fuel used												1828.9443	(219)
Annual totals kWh/year													
Space heating fuel - main system												2426.9387	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3318.8186	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2426.9387	10.2300	248.2758	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.9443	10.2300	187.1010	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			194.2868	(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	2426.9387	0.2160	524.2188	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9443	0.2160	395.0520	(264)
Space and water heating			919.2707	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			432.9343	(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	2426.9387	1.2200	2960.8652	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.9443	1.2200	2231.3121	(264)
Space and water heating			5192.1773	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2315.3893	(272)
Primary energy kWh/m2/year			29.0222	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (42.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£159	£177	-£18
Mains gas	£538	£439	£100
Space heating	£379	£379	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£194	£113	£82
Total cost of uses	£194	£113	£81
Delivered energy	42 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9100	
Infiltration rate			0.4395	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.5183	0.5081	0.4980	0.4471	0.4370	0.3862	0.3862	0.3760	0.4065	0.4370	0.4573	0.4776	(22b)
Effective ac	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1688	42.8138	42.4659	40.8318	40.5260	39.1028	39.1028	38.8392	39.6510	40.5260	41.1446	41.7912	(38)
Heat transfer coeff	99.0504	98.6955	98.3476	96.7134	96.4077	94.9844	94.9844	94.7208	95.5326	96.4077	97.0262	97.6728	(39)
Average = Sum(39)m / 12 =												96.7120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2415	1.2371	1.2327	1.2123	1.2084	1.1906	1.1906	1.1873	1.1975	1.2084	1.2162	1.2243	(40)
HLP (average)												1.2122	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	127.4783	223.8596	324.1358	431.5246	510.6391	518.9529	495.3294	434.4709	361.0362	252.2230	153.9129	108.3034	(83)
Total gains	681.4708	773.4495	852.3453	926.6212	971.8621	949.8411	908.5021	855.9248	801.5595	726.0707	664.7774	647.1454	(84)

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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	33.7474	33.8688	33.9886	34.5629	34.6725	35.1920	35.1920	35.2899	34.9901	34.6725	34.4515	34.2234	
alpha	3.2498	3.2579	3.2659	3.3042	3.3115	3.3461	3.3461	3.3527	3.3327	3.3115	3.2968	3.2816	
util living area													
	0.9663	0.9484	0.9157	0.8481	0.7362	0.5796	0.4409	0.4816	0.6892	0.8739	0.9483	0.9709	(86)
MIT	19.3330	19.5661	19.9167	20.3516	20.6942	20.9026	20.9705	20.9601	20.8192	20.3783	19.7895	19.2970	(87)
Th 2	19.8869	19.8904	19.8939	19.9102	19.9133	19.9275	19.9275	19.9302	19.9220	19.9133	19.9071	19.9006	(88)
util rest of house													
	0.9596	0.9384	0.8991	0.8179	0.6842	0.5004	0.3412	0.3803	0.6148	0.8421	0.9365	0.9651	(89)
MIT 2	17.7045	18.0402	18.5398	19.1518	19.5994	19.8511	19.9124	19.9081	19.7648	19.2047	18.3766	17.6616	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.0409	18.3554	18.8242	19.3996	19.8256	20.0683	20.1310	20.1254	19.9826	19.4472	18.6684	17.9994	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8909	18.2054	18.6742	19.2496	19.6756	19.9183	19.9810	19.9754	19.8326	19.2972	18.5184	17.8494	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9181	0.8759	0.7964	0.6715	0.4997	0.3464	0.3848	0.6080	0.8200	0.9164	0.9497	(94)
Useful gains	642.4862	710.1377	746.5906	737.9250	652.6291	474.6031	314.6726	329.3618	487.3273	595.3704	609.2252	614.5949	(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	1346.1862	1313.1803	1197.3051	1000.9490	768.9057	505.1596	321.1414	338.6687	547.6511	838.4741	1107.8874	1333.1746	(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	523.5528	405.2446	335.3316	189.3773	86.5098	0.0000	0.0000	0.0000	0.0000	180.8691	359.0368	534.6233	(98)
Space heating												2614.5453	(98)
Space heating per m2											(98) / (4) =	32.7719	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2889.0003	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	523.5528	405.2446	335.3316	189.3773	86.5098	0.0000	0.0000	0.0000	0.0000	180.8691	359.0368	534.6233	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	578.5114	447.7841	370.5322	209.2566	95.5909	0.0000	0.0000	0.0000	0.0000	199.8554	396.7257	590.7440	(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													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8027	89.8274	89.8599	89.9339	90.0701	87.3000	87.3000	87.3000	87.3000	89.4495	89.6800	89.8171	(217)
Fuel for water heating, kWh/month													
	156.6847	115.8109	90.0061	43.6618	14.3775	0.0000	0.0000	24.1300	49.2919	95.3237	133.0552	155.7836	(219)
Water heating fuel used												878.1254	(219)
Annual totals kWh/year													
Space heating fuel - main system												2889.0003	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3030.4813	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2889.0003	3.4800	100.5372	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.1254	3.4800	30.5588	(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	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			153.9326	(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] =	0.5181	(257)
SAP value	92.7722	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2889.0003	0.2160	624.0241	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.1254	0.2160	189.6751	(264)
Space and water heating			813.6992	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			431.3807	(272)
CO2 emissions per m2			5.4100	(273)
EI value			95.3674	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9100	
Infiltration rate		0.4395	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4065	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4268	0.3963	0.4065	0.3862	0.3862	0.3760	0.3658	0.3557	0.3455	0.3760	0.3557	0.3760	(22b)
Effective ac	0.5911	0.5785	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.2904	(36)
Total fabric heat loss	(33) + (36) = 55.8816	(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	40.2273	39.3734	39.6510	39.1028	39.1028	38.8392	38.5827	38.3331	38.0907	38.8392	38.3331	38.8392	(38)
Heat transfer coeff	96.1090	95.2550	95.5326	94.9844	94.9844	94.7208	94.4643	94.2148	93.9723	94.7208	94.2148	94.7208	(39)
Average = Sum(39)m / 12 =												94.8245	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2047	1.1940	1.1975	1.1906	1.1906	1.1873	1.1841	1.1809	1.1779	1.1873	1.1809	1.1873	(40)
HLP (average)												1.1886	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

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Energy content (annual)                                                                    Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
              165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3932 (H8)
Utilisation factor                                                                                                                  0.5122 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -875.5295 (H17)
Solar input    -28.5619   -40.6132   -69.8043   -94.1822  -110.6226  -118.1624  -115.6775  -103.5348   -81.0606   -56.0425   -33.7812   -23.4862 (63)
                                                                                          Solar input (sum of months) = Sum(63)m =   -875.5295 (63)
Output from w/h
              136.6020   104.2280    80.5815    38.2368    17.4090     0.0000     0.0000    15.0785    38.3707    81.3959   114.5520   136.9003 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =    763.3548 (64)
Heat gains from water heating, kWh/month
               53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (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)
              -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
               72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
              553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


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6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
Northeast                              5.0600           14.6176           0.4600           0.0000           0.7700           26.1985 (75)
Southeast                              0.7200           45.1778           0.4600           0.0000           0.7700           11.5214 (77)
Southwest                              3.0000           45.1778           0.4600           0.0000           0.7700           48.0060 (79)
Southwest                              4.5100           45.1778           0.4600           0.0000           0.7700           72.1690 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    157.8949   236.5519   347.1161   468.2205   529.1030   585.0786   553.6901   495.9108   409.4920   288.0496   190.1260   131.8038 (83)
Total gains    711.8873   786.1418   875.3256   963.3171   990.3260  1015.9668   966.8627   917.3647   850.0153   761.8973   700.9905   670.6458 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           34.7802    35.0921    34.9901    35.1920    35.1920    35.2899    35.3858    35.4795    35.5711    35.2899    35.4795    35.2899
alpha          3.3187     3.3395     3.3327     3.3461     3.3461     3.3527     3.3591     3.3653     3.3714     3.3527     3.3653     3.3527
util living area
               0.9575     0.9410     0.8999     0.8157     0.6860     0.4995     0.3717     0.3893     0.6179     0.8331     0.9297     0.9627 (86)

MIT           19.5365    19.7189    20.0690    20.4799    20.7829    20.9449    20.9846    20.9824    20.8862    20.5338    20.0091    19.5228 (87)
Th 2          19.9163    19.9248    19.9220    19.9275    19.9275    19.9302    19.9328    19.9353    19.9377    19.9302    19.9353    19.9302 (88)
util rest of house
               0.9490     0.9297     0.8806     0.7805     0.6270     0.4166     0.2741     0.2879     0.5365     0.7923     0.9138     0.9552 (89)
MIT 2         18.0158    18.2806    18.7718    19.3346    19.7173    19.8921    19.9263    19.9278    19.8476    19.4220    18.7061    18.0060 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.3299    18.5777    19.0398    19.5712    19.9374    20.1096    20.1449    20.1457    20.0621    19.6517    18.9753    18.3193 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1799    18.4277    18.8898    19.4212    19.7874    19.9596    19.9949    19.9957    19.9121    19.5017    18.8253    18.1693 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9307	0.9091	0.8577	0.7614	0.6185	0.4190	0.2799	0.2938	0.5344	0.7730	0.8923	0.9381	(94)
Useful gains	662.5704	714.6424	750.7978	733.4421	612.5376	425.6926	270.6353	269.5621	454.2423	588.9606	625.5016	629.1445	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1276.3211	1250.4773	1135.8605	942.3596	692.1885	441.3607	273.4666	272.8157	489.7956	767.3982	1029.3249	1247.4108	(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													
	456.6305	360.0811	286.4867	150.4206	59.2603	0.0000	0.0000	0.0000	0.0000	132.7575	290.7528	459.9901	(98)
Space heating												2196.3796	(98)
Space heating per m2											(98) / (4) =	27.5305	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2426.9387	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	456.6305	360.0811	286.4867	150.4206	59.2603	0.0000	0.0000	0.0000	0.0000	132.7575	290.7528	459.9901	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	504.5641	397.8797	316.5599	166.2106	65.4810	0.0000	0.0000	0.0000	0.0000	146.6934	321.2738	508.2764	(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													
	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7425	89.7614	89.7776	89.8326	89.7530	87.3000	87.3000	87.3000	87.3000	89.2565	89.5720	89.7455	(217)
Fuel for water heating, kWh/month													
	152.2155	116.1168	89.7569	42.5645	19.3966	0.0000	0.0000	17.2721	43.9527	91.1933	127.8881	152.5428	(219)
Water heating fuel used												852.8991	(219)
Annual totals kWh/year													
Space heating fuel - main system												2426.9387	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2392.7733	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2426.9387	10.2300	248.2758	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.8991	10.2300	87.2516	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			112.7973	(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	2426.9387	0.2160	524.2188	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8991	0.2160	184.2262	(264)
Space and water heating			708.4450	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			248.0585 (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	2426.9387	1.2200	2960.8652	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8991	1.2200	1040.5369	(264)
Space and water heating			4001.4021	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1278.1142	(272)
Primary energy kWh/m2/year			16.0205	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.0600	106.0502	0.4600	0.0000	0.9000	222.1582
South East	0.7200	127.3119	0.4600	0.0000	0.9000	37.9491
South West	3.0000	127.3119	0.4600	0.0000	0.9000	158.1213
South West	4.5100	127.3119	0.4600	0.0000	0.9000	237.7091
total:						655.9377

	Jun	Jul	Aug	
Solar gains	705	656	586	(P4)
Internal gains	428	410	418	
Total summer gains	1132	1066	1004	(P5)
Summer gain/loss ratio	3.45	3.25	3.06	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	19.80	21.49	21.30	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-571.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	26, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	91 B	**DER**	9.26	**TER**	18.58
Environmental	93 A	**% DER<TER**	50.17		
CO_2 Emissions (t/year)	0.44	**DFEE**	45.69	**TFEE**	52.95
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.70		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.58 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.26 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.7 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.89 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.06 m², No overhang
Windows facing South West: 7.51 m², No overhang
Windows facing North West: 0.72 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8900	
Infiltration rate		0.4385	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4056	(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	0.5171	0.5070	0.4968	0.4461	0.4360	0.3853	0.3853	0.3752	0.4056	0.4360	0.4563	0.4765	(22b)
Effective ac	0.6337	0.6285	0.6234	0.5995	0.5950	0.5742	0.5742	0.5704	0.5822	0.5950	0.6041	0.6135	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1272	42.7739	42.4276	40.8009	40.4965	39.0797	39.0797	38.8173	39.6254	40.4965	41.1122	41.7559	(38)
Heat transfer coeff	99.0089	98.6555	98.3092	96.6825	96.3781	94.9613	94.9613	94.6990	95.5071	96.3781	96.9938	97.6375	(39)
Average = Sum(39)m / 12 =												96.6810	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2410	1.2366	1.2323	1.2119	1.2080	1.1903	1.1903	1.1870	1.1971	1.2080	1.2158	1.2238	(40)
HLP (average)												1.2118	(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		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	495.2901	585.9189	671.4729	758.6227	818.3397	807.1316	769.1881	712.0567	647.1223	560.6237	490.4540	465.7066	(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	33.7616	33.8825	34.0018	34.5739	34.6831	35.2006	35.2006	35.2981	34.9994	34.6831	34.4629	34.2357	
alpha	3.2508	3.2588	3.2668	3.3049	3.3122	3.3467	3.3467	3.3532	3.3333	3.3122	3.2975	3.2824	
util living area													
	0.9860	0.9752	0.9529	0.9006	0.8018	0.6514	0.5086	0.5600	0.7762	0.9300	0.9770	0.9885	(86)
MIT	19.0491	19.2951	19.6814	20.1789	20.5943	20.8609	20.9548	20.9373	20.7346	20.1877	19.5352	19.0153	(87)
Th 2	19.8873	19.8908	19.8943	19.9105	19.9136	19.9278	19.9278	19.9304	19.9223	19.9136	19.9074	19.9010	(88)
util rest of house													
	0.9830	0.9699	0.9425	0.8778	0.7552	0.5704	0.3982	0.4490	0.7079	0.9091	0.9712	0.9860	(89)
MIT 2	17.2964	17.6548	18.2130	18.9254	19.4841	19.8146	19.9037	19.8941	19.6792	18.9539	18.0166	17.2556	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6584	17.9936	18.5164	19.1844	19.7134	20.0308	20.1208	20.1096	19.8972	19.2087	18.3303	17.6191	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5084	17.8436	18.3664	19.0344	19.5634	19.8808	19.9708	19.9596	19.7472	19.0587	18.1803	17.4691	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9731	0.9557	0.9228	0.8548	0.7378	0.5665	0.4029	0.4523	0.6949	0.8872	0.9576	0.9774	(94)
Useful gains	481.9714	559.9414	619.6668	648.4970	603.7654	457.2674	309.9345	322.0491	449.6937	497.3806	469.6748	455.1964	(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													
	1307.7521	1276.9624	1166.5724	979.8153	757.8638	501.4684	320.0981	337.0905	539.3482	815.2362	1074.7226	1295.5592	(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													
	614.3808	481.8381	406.8978	238.5492	114.6492	0.0000	0.0000	0.0000	0.0000	236.4846	435.6345	625.2299	(98)
Space heating												3153.6641	(98)
Space heating per m2											(98) / (4) =	39.5295	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3484.7117	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	614.3808	481.8381	406.8978	238.5492	114.6492	0.0000	0.0000	0.0000	0.0000	236.4846	435.6345	625.2299	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	678.8738	532.4178	449.6109	263.5903	126.6842	0.0000	0.0000	0.0000	0.0000	261.3089	481.3640	690.8618	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8026	89.7397	89.6136	89.3312	88.7831	87.3000	87.3000	87.3000	87.3000	89.2969	89.6651	89.8278	(217)
Fuel for water heating, kWh/month													
	183.9189	161.4015	167.8159	148.2338	144.2072	128.1956	120.4190	135.8687	136.8056	153.9117	165.4302	178.5488	(219)
Water heating fuel used												1824.7569	(219)
Annual totals kWh/year													
Space heating fuel - main system												3484.7117	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4522.8241	(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	3484.7117	0.2160	752.6977	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.7569	0.2160	394.1475	(264)
Space and water heating			1146.8452	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			738.5768	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.2600	(273)

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

DER		9.2600	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.7563	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.7563	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(65)

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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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(73)

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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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	491.0748	568.6683	640.0081	711.5940	759.4623	746.2500	711.6255	663.7776	609.9173	538.9222	482.4599	464.0122	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9978	0.9950	0.9871	0.9596	0.8805	0.7193	0.5507	0.6074	0.8494	0.9749	0.9953	0.9983	(86)
MIT	19.7243	19.8841	20.1421	20.4836	20.7747	20.9434	20.9880	20.9809	20.8641	20.4866	20.0459	19.7005	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9970	0.9933	0.9824	0.9441	0.8353	0.6274	0.4284	0.4829	0.7776	0.9623	0.9934	0.9977	(89)
MIT 2	18.2350	18.4700	18.8465	19.3420	19.7301	19.9262	19.9596	19.9583	19.8497	19.3556	18.7166	18.2082	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5426	18.7621	19.1141	19.5778	19.9458	20.1363	20.1720	20.1695	20.0592	19.5892	18.9912	18.5165	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9905	0.9774	0.9371	0.8350	0.6439	0.4537	0.5085	0.7856	0.9564	0.9908	0.9965	(94)
Useful gains	488.8589	563.2682	625.5589	666.8318	634.1592	480.5018	322.8865	337.5593	479.1761	515.4323	478.0287	462.4101	(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													
	1348.2853	1308.2782	1186.9455	990.6168	762.9505	505.8679	326.3880	343.6283	547.1576	831.7326	1106.1949	1339.3087	(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													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating												3226.6972	(98)
Space heating per m2											(98) / (4) =	40.4449	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3454.7079	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.4132	500.6468	417.6716	233.1252	95.8207	0.0000	0.0000	0.0000	0.0000	235.3274	452.2796	652.4126	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	684.5966	536.0244	447.1859	249.5987	102.5918	0.0000	0.0000	0.0000	0.0000	251.9566	484.2394	698.5145	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7503	87.5213	87.0461	85.9424	83.8304	80.3000	80.3000	80.3000	80.3000	85.8477	87.2379	87.8354	(217)
Fuel for water heating, kWh/month													
	230.2030	202.5567	211.8976	190.3561	188.9416	173.7253	166.4421	185.5439	187.5930	199.8079	209.8920	224.5539	(219)
Water heating fuel used												2371.5132	(219)
Annual totals kWh/year													
Space heating fuel - main system												3454.7079	(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)												356.9126	(232)
Total delivered energy for all uses												6258.1338	(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	3454.7079	0.2160	746.2169	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2371.5132	0.2160	512.2469	(264)
Space and water heating			1258.4638	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1482.6264	(272)
Emissions per m2 for space and water heating			15.7742	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7742 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.5800	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.3900	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3607	(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	0.4599	0.4509	0.4419	0.3968	0.3878	0.3427	0.3427	0.3337	0.3607	0.3878	0.4058	0.4238	(22b)
Effective ac	0.6058	0.6017	0.5976	0.5787	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5823	0.5898	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	41.2260	40.9465	40.6725	39.3857	39.1449	38.0242	38.0242	37.8166	38.4559	39.1449	39.6320	40.1412	(38)
Heat transfer coeff	97.1076	96.8281	96.5541	95.2673	95.0266	93.9058	93.9058	93.6983	94.3375	95.0266	95.5136	96.0228	(39)
Average = Sum(39)m / 12 =												95.2662	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2172	1.2137	1.2103	1.1941	1.1911	1.1771	1.1771	1.1745	1.1825	1.1911	1.1972	1.2036	(40)
HLP (average)												1.1941	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	463.1837	554.5904	641.7594	731.1024	792.2441	783.0400	746.7968	687.4836	621.7718	533.0036	460.2708	434.3728	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4226	34.5219	34.6199	35.0875	35.1764	35.5962	35.5962	35.6751	35.4333	35.1764	34.9970	34.8115	
alpha	3.2948	3.3015	3.3080	3.3392	3.3451	3.3731	3.3731	3.3783	3.3622	3.3451	3.3331	3.3208	
util living area													
	0.9884	0.9785	0.9575	0.9072	0.8100	0.6609	0.5170	0.5715	0.7881	0.9373	0.9807	0.9906	(86)
MIT	19.0390	19.2861	19.6740	20.1702	20.5894	20.8579	20.9538	20.9350	20.7264	20.1710	19.5158	18.9998	(87)
Th 2	19.9063	19.9091	19.9118	19.9247	19.9271	19.9384	19.9384	19.9405	19.9340	19.9271	19.9222	19.9171	(88)
util rest of house													
	0.9859	0.9739	0.9480	0.8856	0.7647	0.5805	0.4065	0.4603	0.7217	0.9183	0.9757	0.9886	(89)
MIT 2	18.1223	18.3690	18.7529	19.2419	19.6286	19.8588	19.9214	19.9145	19.7612	19.2539	18.6086	18.0913	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3116	18.5585	18.9432	19.4336	19.8271	20.0652	20.1347	20.1253	19.9606	19.4433	18.7960	18.2790	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3116	18.5585	18.9432	19.4336	19.8271	20.0652	20.1347	20.1253	19.9606	19.4433	18.7960	18.2790	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9662	0.9373	0.8738	0.7599	0.5909	0.4280	0.4810	0.7236	0.9074	0.9687	0.9842	(94)
Useful gains	454.3256	535.8716	601.4955	638.8257	602.0580	462.7280	319.6094	330.7066	449.9109	483.6724	445.8748	427.5281	(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													
	1360.6357	1322.5227	1201.4406	1003.5109	772.2901	513.2150	331.9293	349.0524	552.8753	840.3486	1117.1269	1351.9023	(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													
	674.2947	528.6295	446.3591	262.5734	126.6527	0.0000	0.0000	0.0000	0.0000	265.3671	483.3015	687.7344	(98)
Space heating												3474.9124	(98)
Space heating per m2											(98) / (4) =	43.5562	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	882.7146	694.9030	712.1068	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8193	0.8781	0.8508	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	723.2257	610.2000	605.8704	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.1750	962.9391	895.2359	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	204.4435	262.4379	215.2879	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												682.1693	(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	51.1109	65.6095	53.8220	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												170.5423	(107)
Space cooling per m2												2.1377	(108)
Energy for space heating												43.5562	(99)
Energy for space cooling												2.1377	(108)
Total												45.6938	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.7	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	7.5100	36.7938	0.6300	0.7000	0.7700	84.4475	(79)
Northwest	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	104.3782	184.4148	269.9087	363.9040	434.5054	443.1968	422.3644	367.8835	302.1748	208.5588	126.2266	88.5459	(83)
Total gains	446.5894	525.2718	598.8488	673.2482	723.1655	712.5796	679.6484	628.9967	573.7314	499.8465	440.2031	420.2956	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9985	0.9965	0.9902	0.9671	0.8965	0.7427	0.5737	0.6353	0.8724	0.9814	0.9969	0.9989	(86)
MIT	19.6728	19.8344	20.0967	20.4463	20.7507	20.9346	20.9857	20.9768	20.8435	20.4457	19.9973	19.6497	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9980	0.9952	0.9866	0.9540	0.8549	0.6515	0.4477	0.5078	0.8060	0.9717	0.9956	0.9986	(89)
MIT 2	18.7216	18.8851	19.1478	19.5002	19.7816	19.9335	19.9603	19.9594	19.8706	19.5062	19.0589	18.7075	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9181	19.0812	19.3439	19.6956	19.9817	20.1403	20.1721	20.1696	20.0715	19.7003	19.2527	18.9021	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9938	0.9839	0.9500	0.8563	0.6684	0.4740	0.5343	0.8145	0.9685	0.9944	0.9980	(94)
Useful gains	445.4046	522.0373	589.1874	639.6046	619.2224	476.2914	322.1453	336.0853	467.2982	484.1171	437.7201	419.4679	(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													
	1383.8307	1338.3942	1208.5618	1001.5448	766.2731	506.2326	326.3973	343.6335	548.2885	842.0068	1130.5246	1375.3854	(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													
	698.1891	548.5918	460.8146	260.5969	109.4057	0.0000	0.0000	0.0000	0.0000	266.2699	498.8192	711.2027	(98)
Space heating												3553.8899	(98)
Space heating per m2											(98) / (4) =	44.5461	(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	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8637	0.9242	0.8991	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	741.8790	624.9339	622.8739	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	924.8187	884.4540	826.8746	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	131.7166	193.0830	151.7765	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												476.5760	(104)

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	32.9291	48.2707	37.9441	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												119.1440 (107)
Space cooling per m2												1.4934 (108)
Energy for space heating												44.5461 (99)
Energy for space cooling												1.4934 (108)
Total												46.0395 (109)
Target Fabric Energy Efficiency (TFEE)												52.9 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4385	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4056	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4259	0.3954	0.4056	0.3853	0.3853	0.3752	0.3650	0.3549	0.3447	0.3752	0.3549	0.3752	(22b)
Effective ac	0.5907	0.5782	0.5822	0.5742	0.5742	0.5704	0.5666	0.5630	0.5594	0.5704	0.5630	0.5704	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	40.1992	39.3491	39.6254	39.0797	39.0797	38.8173	38.5620	38.3136	38.0722	38.8173	38.3136	38.8173	(38)
Heat transfer coeff	96.0808	95.2307	95.5071	94.9613	94.9613	94.6990	94.4436	94.1952	93.9538	94.6990	94.1952	94.6990	(39)
Average = Sum(39)m / 12 =												94.8022	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2043	1.1937	1.1971	1.1903	1.1903	1.1870	1.1838	1.1807	1.1777	1.1870	1.1807	1.1870	(40)
HLP (average)												1.1883	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (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

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (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)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (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	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southwest	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	150.1013	226.3572	335.9022	458.8315	522.9339	580.2060	548.2979	487.8708	398.3130	276.7272	181.0596	125.0942 (83)
Total gains	704.0937	775.9471	864.1117	953.9281	984.1568	1011.0942	961.4705	909.3247	838.8363	750.5749	691.9241	663.9362 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7904	35.1010	34.9994	35.2006	35.2006	35.2981	35.3935	35.4869	35.5780	35.2981	35.4869	35.2981	
alpha	3.3194	3.3401	3.3333	3.3467	3.3467	3.3532	3.3596	3.3658	3.3719	3.3532	3.3658	3.3532	
util living area	0.9587	0.9429	0.9028	0.8190	0.6886	0.5014	0.3735	0.3924	0.6237	0.8379	0.9319	0.9637	(86)
MIT	19.5260	19.7057	20.0566	20.4727	20.7804	20.9443	20.9844	20.9820	20.8830	20.5241	19.9978	19.5134	(87)
Th 2	19.9165	19.9251	19.9223	19.9278	19.9278	19.9304	19.9330	19.9355	19.9379	19.9304	19.9355	19.9304	(88)
util rest of house	0.9504	0.9318	0.8838	0.7841	0.6296	0.4184	0.2755	0.2903	0.5422	0.7977	0.9164	0.9563	(89)
MIT 2	18.0010	18.2622	18.7552	19.3257	19.7148	19.8919	19.9264	19.9278	19.8449	19.4104	18.6906	17.9929	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3160	18.5604	19.0240	19.5626	19.9349	20.1093	20.1450	20.1456	20.0593	19.6405	18.9607	18.3070	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1660	18.4104	18.8740	19.4126	19.7849	19.9593	19.9950	19.9956	19.9093	19.4905	18.8107	18.1570	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9324	0.9115	0.8610	0.7648	0.6211	0.4207	0.2814	0.2963	0.5398	0.7781	0.8951	0.9395	(94)
Useful gains	656.4747	707.2531	744.0266	729.5558	611.2125	425.3810	270.5357	269.4172	452.8196	584.0479	619.3197	623.7699	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1274.6114	1248.5108	1134.0549	941.3175	691.7873	441.2291	273.4103	272.7516	489.4353	766.1584	1027.7311	1245.9496	(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	459.8937	363.7252	290.1810	152.4685	59.9477	0.0000	0.0000	0.0000	0.0000	135.4902	294.0562	462.9017	(98)
Space heating												2218.6643	(98)
RHI space heating demand												2219	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4385	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4056	(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	0.5171	0.5070	0.4968	0.4461	0.4360	0.3853	0.3853	0.3752	0.4056	0.4360	0.4563	0.4765	(22b)
Effective ac	0.6337	0.6285	0.6234	0.5995	0.5950	0.5742	0.5742	0.5704	0.5822	0.5950	0.6041	0.6135	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1272	42.7739	42.4276	40.8009	40.4965	39.0797	39.0797	38.8173	39.6254	40.4965	41.1122	41.7559	(38)
Heat transfer coeff	99.0089	98.6555	98.3092	96.6825	96.3781	94.9613	94.9613	94.6990	95.5071	96.3781	96.9938	97.6375	(39)
Average = Sum(39)m / 12 =												96.6810	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2410	1.2366	1.2323	1.2119	1.2080	1.1903	1.1903	1.1870	1.1971	1.2080	1.2158	1.2238	(40)
HLP (average)												1.2118	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

Solar gains	120.9724	213.7335	312.8194	421.7583	503.5840	513.6572	489.5128	426.3704	350.2152	241.7160	146.2944	102.6231	(83)
Total gains	674.9649	763.3234	841.0289	916.8548	964.8069	944.5453	902.6854	847.8243	790.7385	715.5636	657.1589	641.4651	(84)

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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	33.7616	33.8825	34.0018	34.5739	34.6831	35.2006	35.2006	35.2981	34.9994	34.6831	34.4629	34.2357	
alpha	3.2508	3.2588	3.2668	3.3049	3.3122	3.3467	3.3467	3.3532	3.3333	3.3122	3.2975	3.2824	
util living area													
	0.9671	0.9501	0.9182	0.8512	0.7391	0.5819	0.4433	0.4855	0.6949	0.8777	0.9498	0.9716	(86)
MIT	19.3244	19.5531	19.9037	20.3430	20.6905	20.9014	20.9700	20.9592	20.8145	20.3679	19.7796	19.2893	(87)
Th 2	19.8873	19.8908	19.8943	19.9105	19.9136	19.9278	19.9278	19.9304	19.9223	19.9136	19.9074	19.9010	(88)
util rest of house													
	0.9606	0.9404	0.9020	0.8214	0.6872	0.5027	0.3432	0.3836	0.6207	0.8465	0.9383	0.9659	(89)
MIT 2	17.6925	18.0220	18.5222	19.1410	19.5955	19.8504	19.9124	19.9078	19.7605	19.1915	18.3629	17.6507	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.0296	18.3383	18.8076	19.3893	19.8217	20.0675	20.1309	20.1250	19.9782	19.4345	18.6556	17.9892	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8796	18.1883	18.6576	19.2393	19.6717	19.9175	19.9809	19.9750	19.8282	19.2845	18.5056	17.8392	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9440	0.9203	0.8790	0.7997	0.6744	0.5019	0.3484	0.3881	0.6135	0.8243	0.9184	0.9507	(94)
Useful gains	637.1679	702.5245	739.2443	733.2276	650.6342	474.0242	314.4749	329.0085	485.1558	589.8408	603.5461	609.8468	(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													
	1344.4964	1310.9611	1195.2036	999.6282	768.2996	504.9564	321.0520	338.5462	547.0853	836.9993	1106.2693	1331.6958	(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													
	526.2524	408.8694	339.2337	191.8085	87.5431	0.0000	0.0000	0.0000	0.0000	183.8859	361.9607	537.0556	(98)
Space heating												2636.6094	(98)
Space heating per m2											(98) / (4) =	33.0485	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2913.3806	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	526.2524	408.8694	339.2337	191.8085	87.5431	0.0000	0.0000	0.0000	0.0000	183.8859	361.9607	537.0556	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	581.4944	451.7894	374.8439	211.9431	96.7327	0.0000	0.0000	0.0000	0.0000	203.1888	399.9566	593.4316	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7145	89.6405	89.4924	89.1652	88.5718	87.3000	87.3000	87.3000	87.3000	89.1030	89.5459	89.7435	(217)
Fuel for water heating, kWh/month													
	184.0995	161.5801	168.0431	148.5098	144.5512	128.1956	120.4190	135.8687	136.8056	154.2467	165.6505	178.7165	(219)
Water heating fuel used												1826.6863	(219)
Annual totals kWh/year													
Space heating fuel - main system												2913.3806	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3953.4224	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2913.3806	3.4800	101.3856	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.6863	3.4800	63.5687	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			181.1959	(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] =	0.6099	(257)
SAP value		91.4920	
SAP rating (Section 12)		91	(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	2913.3806	0.2160	629.2902	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.6863	0.2160	394.5642	(264)
Space and water heating			1023.8544	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			615.5860	(272)
CO2 emissions per m2			7.7200	(273)
EI value			93.3893	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4385	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4056	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4259	0.3954	0.4056	0.3853	0.3853	0.3752	0.3650	0.3549	0.3447	0.3752	0.3549	0.3752	(22b)
Effective ac	0.5907	0.5782	0.5822	0.5742	0.5742	0.5704	0.5666	0.5630	0.5594	0.5704	0.5630	0.5704	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	40.1992	39.3491	39.6254	39.0797	39.0797	38.8173	38.5620	38.3136	38.0722	38.8173	38.3136	38.8173	(38)
Heat transfer coeff	96.0808	95.2307	95.5071	94.9613	94.9613	94.6990	94.4436	94.1952	93.9538	94.6990	94.1952	94.6990	(39)
Average = Sum(39)m / 12 =												94.8022	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2043	1.1937	1.1971	1.1903	1.1903	1.1870	1.1838	1.1807	1.1777	1.1870	1.1807	1.1870	(40)
HLP (average)												1.1883	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (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

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (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)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)
Total internal gains												
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (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	
Northeast	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(75)
Southwest	3.0000	45.1778	0.4600	0.0000	0.7700	48.0060	(79)
Northwest	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(81)
Southwest	4.5100	45.1778	0.4600	0.0000	0.7700	72.1690	(79)

Solar gains	150.1013	226.3572	335.9022	458.8315	522.9339	580.2060	548.2979	487.8708	398.3130	276.7272	181.0596	125.0942 (83)
Total gains	704.0937	775.9471	864.1117	953.9281	984.1568	1011.0942	961.4705	909.3247	838.8363	750.5749	691.9241	663.9362 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7904	35.1010	34.9994	35.2006	35.2006	35.2981	35.3935	35.4869	35.5780	35.2981	35.4869	35.2981	
alpha	3.3194	3.3401	3.3333	3.3467	3.3467	3.3532	3.3596	3.3658	3.3719	3.3532	3.3658	3.3532	
util living area													
	0.9587	0.9429	0.9028	0.8190	0.6886	0.5014	0.3735	0.3924	0.6237	0.8379	0.9319	0.9637	(86)
MIT	19.5260	19.7057	20.0566	20.4727	20.7804	20.9443	20.9844	20.9820	20.8830	20.5241	19.9978	19.5134	(87)
Th 2	19.9165	19.9251	19.9223	19.9278	19.9278	19.9304	19.9330	19.9355	19.9379	19.9304	19.9355	19.9304	(88)
util rest of house													
	0.9504	0.9318	0.8838	0.7841	0.6296	0.4184	0.2755	0.2903	0.5422	0.7977	0.9164	0.9563	(89)
MIT 2	18.0010	18.2622	18.7552	19.3257	19.7148	19.8919	19.9264	19.9278	19.8449	19.4104	18.6906	17.9929	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.3160	18.5604	19.0240	19.5626	19.9349	20.1093	20.1450	20.1456	20.0593	19.6405	18.9607	18.3070	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1660	18.4104	18.8740	19.4126	19.7849	19.9593	19.9950	19.9956	19.9093	19.4905	18.8107	18.1570	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9324	0.9115	0.8610	0.7648	0.6211	0.4207	0.2814	0.2963	0.5398	0.7781	0.8951	0.9395	(94)
Useful gains	656.4747	707.2531	744.0266	729.5558	611.2125	425.3810	270.5357	269.4172	452.8196	584.0479	619.3197	623.7699	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1274.6114	1248.5108	1134.0549	941.3175	691.7873	441.2291	273.4103	272.7516	489.4353	766.1584	1027.7311	1245.9496	(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													
	459.8937	363.7252	290.1810	152.4685	59.9477	0.0000	0.0000	0.0000	0.0000	135.4902	294.0562	462.9017	(98)
Space heating												2218.6643	(98)
Space heating per m2											(98) / (4) =	27.8098	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2451.5627	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	459.8937	363.7252	290.1810	152.4685	59.9477	0.0000	0.0000	0.0000	0.0000	135.4902	294.0562	462.9017	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	508.1699	401.9063	320.6420	168.4734	66.2406	0.0000	0.0000	0.0000	0.0000	149.7129	324.9240	511.4936	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6319	89.5650	89.3816	88.9839	88.2956	87.3000	87.3000	87.3000	87.3000	88.8598	89.4012	89.6544	(217)
Fuel for water heating, kWh/month													
	184.2692	161.7164	168.2514	148.8122	145.0033	128.1956	120.4190	135.8687	136.8056	154.6689	165.9186	178.8942	(219)
Water heating fuel used												1828.8230	(219)
Annual totals kWh/year													
Space heating fuel - main system												2451.5627	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3343.3213	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2451.5627	10.2300	250.7949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.8230	10.2300	187.0886	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			196.7934	(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	2451.5627	0.2160	529.5375	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8230	0.2160	395.0258	(264)
Space and water heating			924.5633	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			438.2269	(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	2451.5627	1.2200	2990.9065	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.8230	1.2200	2231.1641	(264)
Space and water heating			5222.0706	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2345.2826	(272)
Primary energy kWh/m2/year			29.3969	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 81	-185 kg (42.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	2.32 kg/m²	A 93	A 95
Total Savings	£81	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£159	£177	-£18
Mains gas	£541	£441	£100
Space heating	£381	£381	£0
Water heating	£187	£106	£81
Lighting	£131	£131	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£197	£115	£82
Total cost of uses	£196	£115	£81
Delivered energy	42 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.8900	
Infiltration rate			0.4385	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4056	(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	0.5171	0.5070	0.4968	0.4461	0.4360	0.3853	0.3853	0.3752	0.4056	0.4360	0.4563	0.4765	(22b)
Effective ac	0.6337	0.6285	0.6234	0.5995	0.5950	0.5742	0.5742	0.5704	0.5822	0.5950	0.6041	0.6135	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1272	42.7739	42.4276	40.8009	40.4965	39.0797	39.0797	38.8173	39.6254	40.4965	41.1122	41.7559	(38)
Heat transfer coeff	99.0089	98.6555	98.3092	96.6825	96.3781	94.9613	94.9613	94.6990	95.5071	96.3781	96.9938	97.6375	(39)
Average = Sum(39)m / 12 =												96.6810	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2410	1.2366	1.2323	1.2119	1.2080	1.1903	1.1903	1.1870	1.1971	1.2080	1.2158	1.2238	(40)
HLP (average)												1.2118	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                                  Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (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                                                                                                                   1.2449 (H8)
Utilisation factor                                                                                                                    0.5521 (H9)
Collector performance factor                                                                                                          0.8793 (H10)
Dedicated solar storage volume                                                                                                       75.0000 (H11)
Effective solar volume                                                                                                               75.0000 (H13)
Daily hot water demand                                                                                                               92.5935 (H14)
Volume ratio Veff/V                                                                                                                   0.8100 (H15)
Solar storage volume factor                                                                                                           0.9579 (H16)
Solar input                                                                                                                        -843.3953 (H17)
Solar input    -24.4568   -40.8113   -69.5064   -93.1523  -115.0818  -113.1437  -111.6485   -97.5478   -76.3995   -52.1719   -29.0093   -20.4662 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -843.3953 (63)
Output from w/h
             140.7071   104.0299    80.8795    39.2667    12.9499     0.0000     0.0000    21.0655    43.0318    85.2666   119.3239   139.9203 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =    786.4412 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)
```

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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      147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (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)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)
```

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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	
Northeast	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(75)
Southwest	3.0000	36.7938	0.4600	0.0000	0.7700	39.0971	(79)
Northwest	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(81)
Southwest	4.5100	36.7938	0.4600	0.0000	0.7700	58.7760	(79)

```
Solar gains    120.9724   213.7335   312.8194   421.7583   503.5840   513.6572   489.5128   426.3704   350.2152   241.7160   146.2944   102.6231 (83)
Total gains    674.9649   763.3234   841.0289   916.8548   964.8069   944.5453   902.6854   847.8243   790.7385   715.5636   657.1589   641.4651 (84)
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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            33.7616    33.8825    34.0018    34.5739    34.6831    35.2006    35.2006    35.2981    34.9994    34.6831    34.4629    34.2357
alpha           3.2508     3.2588     3.2668     3.3049     3.3122     3.3467     3.3467     3.3532     3.3333     3.3122     3.2975     3.2824
util living area
               0.9671     0.9501     0.9182     0.8512     0.7391     0.5819     0.4433     0.4855     0.6949     0.8777     0.9498     0.9716 (86)

MIT            19.3244    19.5531    19.9037    20.3430    20.6905    20.9014    20.9700    20.9592    20.8145    20.3679    19.7796    19.2893 (87)
Th 2           19.8873    19.8908    19.8943    19.9105    19.9136    19.9278    19.9278    19.9304    19.9223    19.9136    19.9074    19.9010 (88)
util rest of house
               0.9606     0.9404     0.9020     0.8214     0.6872     0.5027     0.3432     0.3836     0.6207     0.8465     0.9383     0.9659 (89)
MIT 2          17.6925    18.0220    18.5222    19.1410    19.5955    19.8504    19.9124    19.9078    19.7605    19.1915    18.3629    17.6507 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2066 (91)
MIT            18.0296    18.3383    18.8076    19.3893    19.8217    20.0675    20.1309    20.1250    19.9782    19.4345    18.6556    17.9892 (92)
Temperature adjustment                                                                                                               -0.1500
adjusted MIT   17.8796    18.1883    18.6576    19.2393    19.6717    19.9175    19.9809    19.9750    19.8282    19.2845    18.5056    17.8392 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9440	0.9203	0.8790	0.7997	0.6744	0.5019	0.3484	0.3881	0.6135	0.8243	0.9184	0.9507	(94)
Useful gains	637.1679	702.5245	739.2443	733.2276	650.6342	474.0242	314.4749	329.0085	485.1558	589.8408	603.5461	609.8468	(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	1344.4964	1310.9611	1195.2036	999.6282	768.2996	504.9564	321.0520	338.5462	547.0853	836.9993	1106.2693	1331.6958	(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	526.2524	408.8694	339.2337	191.8085	87.5431	0.0000	0.0000	0.0000	0.0000	183.8859	361.9607	537.0556	(98)
Space heating												2636.6094	(98)
Space heating per m2											(98) / (4) =	33.0485	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2913.3806	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	526.2524	408.8694	339.2337	191.8085	87.5431	0.0000	0.0000	0.0000	0.0000	183.8859	361.9607	537.0556	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	581.4944	451.7894	374.8439	211.9431	96.7327	0.0000	0.0000	0.0000	0.0000	203.1888	399.9566	593.4316	(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	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8055	89.8321	89.8658	89.9398	90.0745	87.3000	87.3000	87.3000	87.3000	89.4612	89.6850	89.8195	(217)
Fuel for water heating, kWh/month	156.6798	115.8048	90.0002	43.6589	14.3768	0.0000	0.0000	24.1300	49.2919	95.3113	133.0479	155.7794	(219)
Water heating fuel used												878.0810	(219)
Annual totals kWh/year													
Space heating fuel - main system												2913.3806	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3054.8172	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2913.3806	3.4800	101.3856	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	878.0810	3.4800	30.5572	(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	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			154.7795	(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] =	0.5210	(257)
SAP value	92.7324	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2913.3806	0.2160	629.2902	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	878.0810	0.2160	189.6655	(264)
Space and water heating			818.9557	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			436.6372	(272)
CO2 emissions per m2			5.4700	(273)
EI value			95.3110	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.8900	
Infiltration rate		0.4385	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4056	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4259	0.3954	0.4056	0.3853	0.3853	0.3752	0.3650	0.3549	0.3447	0.3752	0.3549	0.3752	(22b)
Effective ac	0.5907	0.5782	0.5822	0.5742	0.5742	0.5704	0.5666	0.5630	0.5594	0.5704	0.5630	0.5704	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (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	40.1992	39.3491	39.6254	39.0797	39.0797	38.8173	38.5620	38.3136	38.0722	38.8173	38.3136	38.8173	(38)
Heat transfer coeff	96.0808	95.2307	95.5071	94.9613	94.9613	94.6990	94.4436	94.1952	93.9538	94.6990	94.1952	94.6990	(39)
Average = Sum(39)m / 12 =												94.8022	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2043	1.1937	1.1971	1.1903	1.1903	1.1870	1.1838	1.1807	1.1777	1.1870	1.1807	1.1870	(40)
HLP (average)												1.1883	(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		2.4587 (42)
Average daily hot water use (litres/day)		92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

```
Energy content (annual)                                                                          Total = Sum(45)m =   1456.8563 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.6567    19.8157    20.4480    17.8271    17.1055    14.7608    13.6780    15.6957    15.8832    18.5103    20.2055    21.9418 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1191    12.7365    14.0656    13.5716    13.9948    13.5096    13.9389    13.9751    13.5434    14.0363    13.6301    14.1076 (61)
Total heat required for water heating calculated for each month
             165.1639   144.8412   150.3858   132.4190   128.0316   111.9147   105.1258   118.6133   119.4313   137.4384   148.3332   160.3865 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3932 (H8)
Utilisation factor                                                                                                                  0.5122 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.5935 (H14)
Volume ratio Veff/V                                                                                                                 0.8100 (H15)
Solar storage volume factor                                                                                                         0.9579 (H16)
Solar input                                                                                                                      -875.5295 (H17)
Solar input    -28.5619   -40.6132   -69.8043   -94.1822  -110.6226  -118.1624  -115.6775  -103.5348   -81.0606   -56.0425   -33.7812   -23.4862 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -875.5295 (63)
Output from w/h
             136.6020   104.2280    80.5815    38.2368    17.4090     0.0000     0.0000    15.0785    38.3707    81.3959   114.5520   136.9003 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    763.3548 (64)
Heat gains from water heating, kWh/month
              53.7522    47.1090    48.8429    42.9096    41.4159    36.0971    33.8044    38.2860    38.5936    44.5403    48.1963    52.1646 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204   147.5204 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.5247    44.8756    36.4953    27.6293    20.6532    17.4363    18.8405    24.4896    32.8699    41.7360    48.7120    51.9289 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             326.8360   330.2276   321.6810   303.4864   280.5189   258.9328   244.5119   241.1204   249.6670   267.8616   290.8290   312.4151 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107    52.2107 (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)
             -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469   -98.3469 (71)
Water heating gains (Table 5)
              72.2475    70.1026    65.6490    59.5967    55.6666    50.1349    45.4360    51.4597    53.6022    59.8660    66.9393    70.1137 (72)
Total internal gains
             553.9924   549.5899   528.2095   495.0966   461.2229   430.8882   413.1726   421.4539   440.5233   473.8477   510.8645   538.8420 (73)


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6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
Northeast                              5.0600           14.6176           0.4600           0.0000           0.7700           26.1985 (75)
Southwest                              3.0000           45.1778           0.4600           0.0000           0.7700           48.0060 (79)
Northwest                              0.7200           14.6176           0.4600           0.0000           0.7700            3.7279 (81)
Southwest                              4.5100           45.1778           0.4600           0.0000           0.7700           72.1690 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    150.1013   226.3572   335.9022   458.8315   522.9339   580.2060   548.2979   487.8708   398.3130   276.7272   181.0596   125.0942 (83)
Total gains    704.0937   775.9471   864.1117   953.9281   984.1568  1011.0942   961.4705   909.3247   838.8363   750.5749   691.9241   663.9362 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           34.7904    35.1010    34.9994    35.2006    35.2006    35.2981    35.3935    35.4869    35.5780    35.2981    35.4869    35.2981
alpha          3.3194     3.3401     3.3333     3.3467     3.3467     3.3532     3.3596     3.3658     3.3719     3.3532     3.3658     3.3532
util living area
               0.9587     0.9429     0.9028     0.8190     0.6886     0.5014     0.3735     0.3924     0.6237     0.8379     0.9319     0.9637 (86)

MIT           19.5260    19.7057    20.0566    20.4727    20.7804    20.9443    20.9844    20.9820    20.8830    20.5241    19.9978    19.5134 (87)
Th 2          19.9165    19.9251    19.9223    19.9278    19.9278    19.9304    19.9330    19.9355    19.9379    19.9304    19.9355    19.9304 (88)
util rest of house
               0.9504     0.9318     0.8838     0.7841     0.6296     0.4184     0.2755     0.2903     0.5422     0.7977     0.9164     0.9563 (89)
MIT 2         18.0010    18.2622    18.7552    19.3257    19.7148    19.8919    19.9264    19.9278    19.8449    19.4104    18.6906    17.9929 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2066 (91)
MIT           18.3160    18.5604    19.0240    19.5626    19.9349    20.1093    20.1450    20.1456    20.0593    19.6405    18.9607    18.3070 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1660    18.4104    18.8740    19.4126    19.7849    19.9593    19.9950    19.9956    19.9093    19.4905    18.8107    18.1570 (93)
```

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9324	0.9115	0.8610	0.7648	0.6211	0.4207	0.2814	0.2963	0.5398	0.7781	0.8951	0.9395	(94)
Useful gains	656.4747	707.2531	744.0266	729.5558	611.2125	425.3810	270.5357	269.4172	452.8196	584.0479	619.3197	623.7699	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1274.6114	1248.5108	1134.0549	941.3175	691.7873	441.2291	273.4103	272.7516	489.4353	766.1584	1027.7311	1245.9496	(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	459.8937	363.7252	290.1810	152.4685	59.9477	0.0000	0.0000	0.0000	0.0000	135.4902	294.0562	462.9017	(98)
Space heating												2218.6643	(98)
Space heating per m2											(98) / (4) =	27.8098	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2451.5627	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	459.8937	363.7252	290.1810	152.4685	59.9477	0.0000	0.0000	0.0000	0.0000	135.4902	294.0562	462.9017	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	508.1699	401.9063	320.6420	168.4734	66.2406	0.0000	0.0000	0.0000	0.0000	149.7129	324.9240	511.4936	(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	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7466	89.7671	89.7847	89.8397	89.7596	87.3000	87.3000	87.3000	87.3000	89.2719	89.5795	89.7491	(217)
Fuel for water heating, kWh/month	152.2085	116.1094	89.7497	42.5611	19.3951	0.0000	0.0000	17.2721	43.9527	91.1775	127.8775	152.5366	(219)
Water heating fuel used												852.8402	(219)

Annual totals kWh/year		
Space heating fuel - main system	2451.5627	(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)	356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771	-1368.9771	(233)
Total delivered energy for all uses	2417.3385	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2451.5627	10.2300	250.7949	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.8402	10.2300	87.2456	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.9126	36.7200	131.0583	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			115.3103	(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	2451.5627	0.2160	529.5375	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8402	0.2160	184.2135	(264)
Space and water heating			713.7510	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			253.3646 (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	2451.5627	1.2200	2990.9065	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.8402	1.2200	1040.4651	(264)
Space and water heating			4031.3716	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1308.0836	(272)
Primary energy kWh/m2/year			16.3961	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23 (P1)
Transmission heat loss coefficient	55.88 (37)
Summer heat loss coefficient	328.11 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.0600	106.0502	0.4600	0.0000	0.9000	222.1582
South West	3.0000	127.3119	0.4600	0.0000	0.9000	158.1213
North West	0.7200	106.0502	0.4600	0.0000	0.9000	31.6114
South West	4.5100	127.3119	0.4600	0.0000	0.9000	237.7091
total:						649.6001

	Jun	Jul	Aug	
Solar gains	699	650	576	(P4)
Internal gains	428	410	418	
Total summer gains	1127	1060	995	(P5)
Summer gain/loss ratio	3.43	3.23	3.03	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	19.78	21.47	21.28	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-572.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	3-As-SEMI
Property	28, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	92 A	**DER**	8.84	**TER**	17.39
Environmental	93 A	**% DER<TER**	49.16		
CO_2 Emissions (t/year)	0.52	**DFEE**	41.91	**TFEE**	50.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.79		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 94 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.39 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.84 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)41.9 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (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: 3.25 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.12 m², No overhang
Windows facing South East: 1.54 m², No overhang
Windows facing South West: 7.82 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.035 W/m²K
Air permeability 3.3 m³/m²h
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				3.2500	
Infiltration rate				0.2860	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2645	(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	0.3373	0.3306	0.3240	0.2910	0.2844	0.2513	0.2513	0.2447	0.2645	0.2844	0.2976	0.3108	(22b)
Effective ac	0.5569	0.5547	0.5525	0.5423	0.5404	0.5316	0.5316	0.5299	0.5350	0.5404	0.5443	0.5483	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.6536	44.4766	44.3030	43.4877	43.3352	42.6251	42.6251	42.4936	42.8986	43.3352	43.6437	43.9664	(38)
Heat transfer coeff	105.1343	104.9572	104.7837	103.9684	103.8158	103.1058	103.1058	102.9743	103.3793	103.8158	104.1244	104.4470	(39)
Average = Sum(39)m / 12 =												103.9677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1185	1.1166	1.1147	1.1060	1.1044	1.0969	1.0969	1.0955	1.0998	1.1044	1.1077	1.1111	(40)
HLP (average)												1.1060	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	411.8538	409.5270	394.5029	370.2917	345.6020	322.0051	306.8291	313.2546	325.8427	350.2772	378.2818	399.3869	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	550.3021	650.8247	739.1838	821.7174	873.4613	855.8231	817.4184	765.3264	707.2550	620.8794	545.1069	517.2253	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7531	35.8134	35.8727	36.1540	36.2071	36.4565	36.4565	36.5030	36.3600	36.2071	36.0998	35.9883	
alpha	3.3835	3.3876	3.3915	3.4103	3.4138	3.4304	3.4304	3.4335	3.4240	3.4138	3.4067	3.3992	
util living area													
	0.9864	0.9754	0.9534	0.9042	0.8105	0.6653	0.5196	0.5674	0.7773	0.9296	0.9773	0.9889	(86)
MIT	19.1609	19.3995	19.7636	20.2164	20.6080	20.8619	20.9559	20.9398	20.7507	20.2351	19.6091	19.1111	(87)
Th 2	19.9858	19.9873	19.9888	19.9959	19.9972	20.0034	20.0034	20.0045	20.0010	19.9972	19.9945	19.9917	(88)
util rest of house													
	0.9836	0.9704	0.9438	0.8834	0.7680	0.5897	0.4155	0.4633	0.7137	0.9100	0.9719	0.9866	(89)
MIT 2	17.5255	17.8722	18.3976	19.0428	19.5724	19.8863	19.9782	19.9674	19.7660	19.0819	18.1840	17.4569	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	17.8213	18.1484	18.6447	19.2551	19.7597	20.0627	20.1550	20.1433	19.9441	19.2905	18.4418	17.7561	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6713	17.9984	18.4947	19.1051	19.6097	19.9127	20.0050	19.9933	19.7941	19.1405	18.2918	17.6061	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9741	0.9566	0.9246	0.8605	0.7490	0.5822	0.4157	0.4620	0.6984	0.8879	0.9585	0.9784	(94)
Useful gains	536.0494	622.5488	683.4553	707.0533	654.2138	498.2481	339.7803	353.5988	493.9609	551.2966	522.5109	506.0390	(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													
	1405.7817	1374.7697	1256.8443	1061.0034	821.1524	547.7729	351.0768	370.0146	588.6518	886.6341	1165.3354	1400.2244	(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													
	647.0809	505.4924	426.6014	254.8441	124.2023	0.0000	0.0000	0.0000	0.0000	249.4911	462.8336	665.2739	(98)
Space heating												3335.8198	(98)
Space heating per m2											(98) / (4) =	35.4874	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3685.9887	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.0809	505.4924	426.6014	254.8441	124.2023	0.0000	0.0000	0.0000	0.0000	249.4911	462.8336	665.2739	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	715.0065	558.5552	471.3828	281.5957	137.2401	0.0000	0.0000	0.0000	0.0000	275.6807	511.4184	735.1093	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8036	89.7386	89.6121	89.3437	88.8080	87.3000	87.3000	87.3000	87.3000	89.3002	89.6719	89.8343	(217)
Fuel for water heating, kWh/month													
	193.3415	169.6589	176.3621	155.6823	151.3757	134.5226	126.2819	142.5977	143.6163	161.6669	173.8419	187.6602	(219)
Water heating fuel used												1916.6079	(219)
Annual totals kWh/year													
Space heating fuel - main system												3685.9887	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4872.8118	(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	3685.9887	0.2160	796.1736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1916.6079	0.2160	413.9873	(264)
Space and water heating			1210.1609	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			831.4026	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.8400	(273)

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

DER		8.8400	ZC1
Total Floor Area	TFA	94.0000	
Assumed number of occupants	N	2.6766	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5235	ZC2
CO2 emissions from cooking, equation (L16)		1.9493	ZC3
Total CO2 emissions		26.3129	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.3129	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8187	47.2508	46.8329	43.3936	44.8400	46.8329	47.2508	50.8187	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
								Total per year (kWh/year) = Sum(64)m =				2113.5938	(64)
Heat gains from water heating, kWh/month													
	65.7696	57.8871	60.5649	53.5384	51.7451	45.3971	43.2245	48.4453	48.9886	56.0296	59.6213	64.0963	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	88.4000	86.1415	81.4045	74.3589	69.5498	63.0516	58.0975	65.1147	68.0397	75.3085	82.8073	86.1510	(72)
Total internal gains													
	424.2260	421.9032	406.8408	381.9756	356.6272	332.3736	317.2055	324.2871	337.5375	362.6260	390.6641	411.7631	(73)

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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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southeast	1.5400	36.7938	0.6300	0.7000	0.7700	17.3168	(77)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)

Solar gains	119.4568	208.1980	297.3997	389.5018	455.4507	460.5921	440.5497	390.0593	329.0925	233.4826	143.9410	101.6740	(83)
Total gains	543.6828	630.1012	704.2405	771.4774	812.0779	792.9657	757.7552	714.3464	666.6300	596.1087	534.6051	513.4371	(84)

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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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9983	0.9961	0.9897	0.9675	0.9002	0.7487	0.5760	0.6288	0.8633	0.9787	0.9964	0.9988	(86)
MIT	19.7777	19.9307	20.1732	20.4913	20.7700	20.9408	20.9879	20.9812	20.8678	20.5066	20.0849	19.7540	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9978	0.9947	0.9860	0.9548	0.8606	0.6609	0.4550	0.5071	0.7967	0.9681	0.9949	0.9983	(89)
MIT 2	18.3506	18.5757	18.9301	19.3939	19.7707	19.9728	20.0091	20.0077	19.9003	19.4231	18.8103	18.3231	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.6087	18.8208	19.1549	19.5924	19.9514	20.1479	20.1862	20.1838	20.0753	19.6191	19.0408	18.5819	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6087	18.8208	19.1549	19.5924	19.9514	20.1479	20.1862	20.1838	20.0753	19.6191	19.0408	18.5819	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9925	0.9816	0.9480	0.8582	0.6739	0.4769	0.5289	0.8019	0.9624	0.9927	0.9974	(94)
Useful gains	541.8229	625.3520	691.3117	731.3922	696.8991	534.3831	361.3714	377.8468	534.5436	573.7094	530.7186	512.1164	(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													
	1507.7178	1462.6384	1325.8874	1105.3995	850.9052	565.3902	365.4683	384.7571	611.7350	930.0661	1237.6482	1498.5735	(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													
	718.6258	562.6565	472.1243	269.2852	114.5806	0.0000	0.0000	0.0000	0.0000	265.1294	508.9893	733.9241	(98)
Space heating												3645.3152	(98)
Space heating per m2											(98) / (4) =	38.7799	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3902.9071	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	718.6258	562.6565	472.1243	269.2852	114.5806	0.0000	0.0000	0.0000	0.0000	265.1294	508.9893	733.9241	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	769.4066	602.4159	505.4864	288.3139	122.6773	0.0000	0.0000	0.0000	0.0000	283.8644	544.9565	785.7860	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8958	87.6659	87.1970	86.1647	84.1211	80.3000	80.3000	80.3000	80.3000	86.0093	87.3944	87.9801	(217)
Fuel for water heating, kWh/month													
	239.4280	211.6181	223.3555	200.4785	198.8139	183.4366	175.7462	195.9159	198.0796	210.5809	219.1767	233.4787	(219)
Water heating fuel used												2490.1088	(219)
Annual totals kWh/year													
Space heating fuel - main system												3902.9071	(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)												413.7723	(232)
Total delivered energy for all uses												6881.7882	(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	3902.9071	0.2160	843.0279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2490.1088	0.2160	537.8635	(264)
Space and water heating			1380.8914	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Total CO2, kg/m2/year			1634.5643	(272)
Emissions per m2 for space and water heating			14.6903	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2846	(272b)
Emissions per m2 for pumps and fans			0.4141	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6903 * 1.00) + 2.2846 + 0.4141, rounded to 2 d.p.			17.3900	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			3.2500	
Infiltration rate			0.2860	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2645	(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	0.3373	0.3306	0.3240	0.2910	0.2844	0.2513	0.2513	0.2447	0.2645	0.2844	0.2976	0.3108	(22b)
Effective ac	0.5569	0.5547	0.5525	0.5423	0.5404	0.5316	0.5316	0.5299	0.5350	0.5404	0.5443	0.5483	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.6536	44.4766	44.3030	43.4877	43.3352	42.6251	42.6251	42.4936	42.8986	43.3352	43.6437	43.9664	(38)
Heat transfer coeff	105.1343	104.9572	104.7837	103.9684	103.8158	103.1058	103.1058	102.9743	103.3793	103.8158	104.1244	104.4470	(39)
Average = Sum(39)m / 12 =												103.9677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1185	1.1166	1.1147	1.1060	1.1044	1.0969	1.0969	1.0955	1.0998	1.1044	1.1077	1.1111	(40)
HLP (average)												1.1060	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	516.8271	618.1688	708.2293	793.0795	846.3283	830.8067	794.1978	739.8015	680.9088	592.1359	513.6604	484.5660	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7531	35.8134	35.8727	36.1540	36.2071	36.4565	36.4565	36.5030	36.3600	36.2071	36.0998	35.9883	
alpha	3.3835	3.3876	3.3915	3.4103	3.4138	3.4304	3.4304	3.4335	3.4240	3.4138	3.4067	3.3992	
util living area													
	0.9887	0.9787	0.9584	0.9118	0.8215	0.6783	0.5321	0.5824	0.7916	0.9375	0.9809	0.9908	(86)
MIT	19.1126	19.3543	19.7242	20.1862	20.5886	20.8531	20.9526	20.9347	20.7343	20.2015	19.5652	19.0635	(87)
Th 2	19.9858	19.9873	19.9888	19.9959	19.9972	20.0034	20.0034	20.0045	20.0010	19.9972	19.9945	19.9917	(88)
util rest of house													
	0.9864	0.9744	0.9497	0.8923	0.7802	0.6030	0.4265	0.4772	0.7297	0.9197	0.9763	0.9890	(89)
MIT 2	18.2583	18.4988	18.8644	19.3174	19.6912	19.9177	19.9848	19.9768	19.8285	19.3411	18.7153	18.2139	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.4128	18.6535	19.0199	19.4745	19.8535	20.0869	20.1598	20.1500	19.9923	19.4967	18.8690	18.3675	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4128	18.6535	19.0199	19.4745	19.8535	20.0869	20.1598	20.1500	19.9923	19.4967	18.8690	18.3675	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9814	0.9669	0.9391	0.8801	0.7735	0.6098	0.4440	0.4936	0.7291	0.9085	0.9693	0.9848	(94)
Useful gains	507.2339	597.6919	665.0695	698.0194	654.6332	506.6640	352.5849	365.1784	496.4408	537.9290	497.8902	477.1833	(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													
	1483.7377	1443.5337	1311.8806	1099.4154	846.4588	565.7300	367.0348	386.1573	609.1446	923.6227	1225.4416	1479.7548	(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													
	726.5188	568.4057	481.2274	289.0051	142.7182	0.0000	0.0000	0.0000	0.0000	286.9561	523.8370	745.9132	(98)
Space heating												3764.5815	(98)
Space heating per m2											(98) / (4) =	40.0487	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	969.1942	762.9827	782.6044	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8120	0.8736	0.8484	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	787.0209	666.5694	663.9527	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1073.2673	1028.3620	966.7569	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	206.0975	269.1737	225.2864	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												700.5575	(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	51.5244	67.2934	56.3216	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												175.1394	(107)
Space cooling per m2												1.8632	(108)
Energy for space heating												40.0487	(99)
Energy for space cooling												1.8632	(108)
Total												41.9119	(109)
Dwelling Fabric Energy Efficiency (DFEE)												41.9	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southeast	1.5400	36.7938	0.6300	0.7000	0.7700	17.3168	(77)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)

Solar gains	119.4568	208.1980	297.3997	389.5018	455.4507	460.5921	440.5497	390.0593	329.0925	233.4826	143.9410	101.6740	(83)
Total gains	497.8356	585.0690	660.9481	731.1557	773.9198	757.5808	724.1583	677.7890	628.5889	555.0163	490.7763	468.4016	(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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9989	0.9972	0.9922	0.9737	0.9145	0.7716	0.5994	0.6567	0.8847	0.9842	0.9976	0.9992	(86)
MIT	19.7320	19.8863	20.1318	20.4565	20.7465	20.9316	20.9855	20.9771	20.8482	20.4692	20.0414	19.7089	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9985	0.9962	0.9893	0.9631	0.8785	0.6852	0.4751	0.5324	0.8235	0.9760	0.9965	0.9989	(89)
MIT 2	18.8231	18.9791	19.2253	19.5538	19.8253	19.9808	20.0099	20.0089	19.9215	19.5715	19.1442	18.8082	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.9875	19.1432	19.3892	19.7171	19.9919	20.1527	20.1863	20.1840	20.0891	19.7338	19.3065	18.9711	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9875	19.1432	19.3892	19.7171	19.9919	20.1527	20.1863	20.1840	20.0891	19.7338	19.3065	18.9711	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9951	0.9870	0.9593	0.8780	0.6986	0.4978	0.5550	0.8294	0.9730	0.9955	0.9985	(94)
Useful gains	496.8310	582.2117	652.3501	701.3616	679.4924	529.2258	360.4909	376.1605	521.3463	540.0429	488.5842	467.7116	(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													
	1547.6337	1496.5118	1350.4389	1118.2935	855.0775	565.8824	365.4877	384.7785	613.1458	941.8994	1265.1809	1539.1249	(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													
	781.7972	614.4097	519.3780	300.1910	130.6354	0.0000	0.0000	0.0000	0.0000	298.9813	559.1497	797.1315	(98)
Space heating												4001.6737	(98)
Space heating per m2											(98) / (4) =	42.5710	(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	957.9624	754.1406	772.8182	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8531	0.9192	0.8953	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	817.2100	693.1896	691.8941	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.6786	946.4976	894.2749	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	122.7374	188.4612	150.5712	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												461.7698	(104)

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	30.6844	47.1153	37.6428	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												115.4425 (107)
Space cooling per m2												1.2281 (108)
Energy for space heating												42.5710 (99)
Energy for space cooling												1.2281 (108)
Total												43.7991 (109)
Target Fabric Energy Efficiency (TFEE)												50.4 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		3.2500	
Infiltration rate		0.2860	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2645	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.2777	0.2579	0.2645	0.2513	0.2513	0.2447	0.2381	0.2315	0.2248	0.2447	0.2315	0.2447	(22b)
Effective ac	0.5386	0.5333	0.5350	0.5316	0.5316	0.5299	0.5283	0.5268	0.5253	0.5299	0.5268	0.5299	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1861	42.7601	42.8986	42.6251	42.6251	42.4936	42.3656	42.2411	42.1201	42.4936	42.2411	42.4936	(38)
Heat transfer coeff	103.6668	103.2408	103.3793	103.1058	103.1058	102.9743	102.8463	102.7218	102.6008	102.9743	102.7218	102.9743	(39)
Average = Sum(39)m / 12 =												103.0260	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1028	1.0983	1.0998	1.0969	1.0969	1.0955	1.0941	1.0928	1.0915	1.0955	1.0928	1.0955	(40)
HLP (average)												1.0960	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m
23.9232 20.9234 21.5911 18.8236 18.0617 15.5859 14.4426 16.5731 16.7711 19.5451 21.3350 23.1684 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 14.1393 12.7601 14.1011 13.6014 14.0221 13.5322 13.9599 14.0003 13.5699 14.0684 13.6542 14.1273 (61)
Total heat required for water heating calculated for each month
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (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
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (64)
Total per year (kWh/year) = Sum(64)m = 1703.8311 (64)
RHI water heating demand 1704 (64)
Heat gains from water heating, kWh/month
56.5647 49.5703 51.3855 45.1261 43.5424 37.9318 35.5045 40.2372 40.5683 46.8420 50.7060 54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southeast	1.5400	45.1778	0.4600	0.0000	0.7700	24.6431	(77)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	171.1102	254.2677	367.8458	488.1156	545.3413	600.2941	569.1876	514.3050	431.0642	308.0873	205.5918	143.1222	(83)
Total gains	783.5136	861.6734	951.2267	1034.3663	1053.5269	1074.6346	1023.9775	978.1913	916.5394	830.9158	769.8005	738.6839	(84)

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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	36.2592	36.4088	36.3600	36.4565	36.4565	36.5030	36.5485	36.5928	36.6359	36.5030	36.5928	36.5030	
alpha	3.4173	3.4273	3.4240	3.4304	3.4304	3.4335	3.4366	3.4395	3.4424	3.4335	3.4395	3.4335	
util living area													
	0.9585	0.9428	0.9035	0.8240	0.6985	0.5128	0.3820	0.3981	0.6260	0.8365	0.9316	0.9639	(86)
MIT	19.6020	19.7672	20.1040	20.4914	20.7856	20.9453	20.9849	20.9829	20.8890	20.5521	20.0402	19.5723	(87)
Th 2	19.9985	20.0022	20.0010	20.0034	20.0034	20.0045	20.0056	20.0067	20.0078	20.0045	20.0067	20.0045	(88)
util rest of house													
	0.9507	0.9324	0.8858	0.7917	0.6436	0.4343	0.2888	0.3016	0.5496	0.7986	0.9169	0.9570	(89)
MIT 2	18.1689	18.4067	18.8816	19.4135	19.7898	19.9648	19.9987	19.9989	19.9163	19.5074	18.8039	18.1312	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.4281	18.6527	19.1026	19.6085	19.9699	20.1421	20.1771	20.1768	20.0922	19.6963	19.0275	18.3918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2781	18.5027	18.9526	19.4585	19.8199	19.9921	20.0271	20.0268	19.9422	19.5463	18.8775	18.2418	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9328	0.9121	0.8629	0.7714	0.6325	0.4332	0.2909	0.3037	0.5441	0.7781	0.8954	0.9402	(94)
Useful gains	730.8537	785.9016	820.8419	797.9390	666.4024	465.5689	297.8621	297.0296	498.7155	646.5502	689.3040	694.5087	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1386.8653	1363.0617	1235.6559	1026.7742	754.7251	483.1687	301.0407	300.6487	537.8586	838.8621	1127.6297	1363.5658	(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													
	488.0727	387.8516	308.6216	164.7613	65.7121	0.0000	0.0000	0.0000	0.0000	143.0800	315.5945	497.7784	(98)
Space heating												2371.4722	(98)
RHI space heating demand												2371	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				3.2500	
Infiltration rate				0.2860	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2645	(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	0.3373	0.3306	0.3240	0.2910	0.2844	0.2513	0.2513	0.2447	0.2645	0.2844	0.2976	0.3108	(22b)
Effective ac	0.5569	0.5547	0.5525	0.5423	0.5404	0.5316	0.5316	0.5299	0.5350	0.5404	0.5443	0.5483	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.6536	44.4766	44.3030	43.4877	43.3352	42.6251	42.6251	42.4936	42.8986	43.3352	43.6437	43.9664	(38)
Heat transfer coeff	105.1343	104.9572	104.7837	103.9684	103.8158	103.1058	103.1058	102.9743	103.3793	103.8158	104.1244	104.4470	(39)
Average = Sum(39)m / 12 =												103.9677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1185	1.1166	1.1147	1.1060	1.1044	1.0969	1.0969	1.0955	1.0998	1.1044	1.1077	1.1111	(40)
HLP (average)												1.1060	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
								Total per year (kWh/year) = Sum(64)m =				1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	750.8517	848.7034	928.0618	997.6764	1036.0449	1008.1586	965.3792	915.9581	866.8875	793.4307	731.0338	713.4002	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7531	35.8134	35.8727	36.1540	36.2071	36.4565	36.4565	36.5030	36.3600	36.2071	36.0998	35.9883	
alpha	3.3835	3.3876	3.3915	3.4103	3.4138	3.4304	3.4304	3.4335	3.4240	3.4138	3.4067	3.3992	
util living area													
	0.9669	0.9492	0.9174	0.8534	0.7454	0.5922	0.4506	0.4897	0.6935	0.8754	0.9492	0.9716	(86)
MIT	19.4386	19.6586	19.9861	20.3814	20.7059	20.9041	20.9715	20.9617	20.8291	20.4138	19.8542	19.3871	(87)
Th 2	19.9858	19.9873	19.9888	19.9959	19.9972	20.0034	20.0034	20.0045	20.0010	19.9972	19.9945	19.9917	(88)
util rest of house													
	0.9607	0.9400	0.9021	0.8258	0.6975	0.5178	0.3562	0.3942	0.6243	0.8459	0.9383	0.9663	(89)
MIT 2	17.9255	18.2415	18.7079	19.2612	19.6879	19.9249	19.9877	19.9819	19.8474	19.3185	18.5319	17.8554	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.1991	18.4978	18.9391	19.4638	19.8720	20.1020	20.1656	20.1591	20.0249	19.5166	18.7710	18.1324	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0491	18.3478	18.7891	19.3138	19.7220	19.9520	20.0156	20.0091	19.8749	19.3666	18.6210	17.9824	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9445	0.9203	0.8794	0.8038	0.6829	0.5137	0.3574	0.3946	0.6147	0.8233	0.9185	0.9514	(94)
Useful gains	709.1532	781.0362	816.1450	801.9142	707.4854	517.8695	345.0533	361.4821	532.8634	653.2426	671.4890	678.7261	(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													
	1445.5046	1411.4408	1287.6960	1082.7022	832.8140	551.8225	352.1710	371.6461	597.0097	910.1138	1199.6187	1439.5306	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	547.8454	423.6319	350.8339	202.1673	93.2444	0.0000	0.0000	0.0000	0.0000	191.1121	380.2534	566.0385	(98)
Space heating												2755.1271	(98)
Space heating per m2											(98) / (4) =	29.3099	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3044.3393	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	547.8454	423.6319	350.8339	202.1673	93.2444	0.0000	0.0000	0.0000	0.0000	191.1121	380.2534	566.0385	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	605.3541	468.1015	387.6618	223.3893	103.0325	0.0000	0.0000	0.0000	0.0000	211.1736	420.1695	625.4569	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7086	89.6314	89.4813	89.1678	88.5828	87.3000	87.3000	87.3000	87.3000	89.0946	89.5456	89.7451	(217)
Fuel for water heating, kWh/month													
	193.5461	169.8618	176.6197	155.9894	151.7605	134.5226	126.2819	142.5977	143.6163	162.0399	174.0869	187.8467	(219)
Water heating fuel used												1918.7694	(219)
Annual totals kWh/year													
Space heating fuel - main system												3044.3393	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4233.3240	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3044.3393	3.4800	105.9430	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1918.7694	3.4800	66.7732	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			196.4576	(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] =	0.5936	(257)
SAP value		91.7191	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	3044.3393	0.2160	657.5773	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1918.7694	0.2160	414.4542	(264)
Space and water heating			1072.0315	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			693.2732	(272)
CO2 emissions per m2			7.3800	(273)
EI value			93.3166	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8868 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8868 = 0.2436, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		3.2500	
Infiltration rate		0.2860	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2645	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.2777	0.2579	0.2645	0.2513	0.2513	0.2447	0.2381	0.2315	0.2248	0.2447	0.2315	0.2447	(22b)
Effective ac	0.5386	0.5333	0.5350	0.5316	0.5316	0.5299	0.5283	0.5268	0.5253	0.5299	0.5268	0.5299	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1861	42.7601	42.8986	42.6251	42.6251	42.4936	42.3656	42.2411	42.1201	42.4936	42.2411	42.4936	(38)
Heat transfer coeff	103.6668	103.2408	103.3793	103.1058	103.1058	102.9743	102.8463	102.7218	102.6008	102.9743	102.7218	102.9743	(39)
Average = Sum(39)m / 12 =												103.0260	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1028	1.0983	1.0998	1.0969	1.0969	1.0955	1.0941	1.0928	1.0915	1.0955	1.0928	1.0955	(40)
HLP (average)												1.0960	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southeast	1.5400	45.1778	0.4600	0.0000	0.7700	24.6431	(77)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	171.1102	254.2677	367.8458	488.1156	545.3413	600.2941	569.1876	514.3050	431.0642	308.0873	205.5918	143.1222	(83)
Total gains	783.5136	861.6734	951.2267	1034.3663	1053.5269	1074.6346	1023.9775	978.1913	916.5394	830.9158	769.8005	738.6839	(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	36.2592	36.4088	36.3600	36.4565	36.4565	36.5030	36.5485	36.5928	36.6359	36.5030	36.5928	36.5030	
alpha	3.4173	3.4273	3.4240	3.4304	3.4304	3.4335	3.4366	3.4395	3.4424	3.4335	3.4395	3.4335	
util living area													
	0.9585	0.9428	0.9035	0.8240	0.6985	0.5128	0.3820	0.3981	0.6260	0.8365	0.9316	0.9639	(86)
MIT	19.6020	19.7672	20.1040	20.4914	20.7856	20.9453	20.9849	20.9829	20.8890	20.5521	20.0402	19.5723	(87)
Th 2	19.9985	20.0022	20.0010	20.0034	20.0034	20.0045	20.0056	20.0067	20.0078	20.0045	20.0067	20.0045	(88)
util rest of house													
	0.9507	0.9324	0.8858	0.7917	0.6436	0.4343	0.2888	0.3016	0.5496	0.7986	0.9169	0.9570	(89)
MIT 2	18.1689	18.4067	18.8816	19.4135	19.7898	19.9648	19.9987	19.9989	19.9163	19.5074	18.8039	18.1312	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.4281	18.6527	19.1026	19.6085	19.9699	20.1421	20.1771	20.1768	20.0922	19.6963	19.0275	18.3918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2781	18.5027	18.9526	19.4585	19.8199	19.9921	20.0271	20.0268	19.9422	19.5463	18.8775	18.2418	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9328	0.9121	0.8629	0.7714	0.6325	0.4332	0.2909	0.3037	0.5441	0.7781	0.8954	0.9402	(94)
Useful gains	730.8537	785.9016	820.8419	797.9390	666.4024	465.5689	297.8621	297.0296	498.7155	646.5502	689.3040	694.5087	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1386.8653	1363.0617	1235.6559	1026.7742	754.7251	483.1687	301.0407	300.6487	537.8586	838.8621	1127.6297	1363.5658	(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													
	488.0727	387.8516	308.6216	164.7613	65.7121	0.0000	0.0000	0.0000	0.0000	143.0800	315.5945	497.7784	(98)
Space heating												2371.4722	(98)
Space heating per m2											(98) / (4) =	25.2284	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2620.4113	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	488.0727	387.8516	308.6216	164.7613	65.7121	0.0000	0.0000	0.0000	0.0000	143.0800	315.5945	497.7784	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	539.3068	428.5653	341.0183	182.0567	72.6100	0.0000	0.0000	0.0000	0.0000	158.0995	348.7232	550.0314	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6378	89.5744	89.3903	89.0065	88.3254	87.3000	87.3000	87.3000	87.3000	88.8640	89.4163	89.6685	(217)
Fuel for water heating, kWh/month													
	193.6990	169.9698	176.7996	156.2720	152.2028	134.5226	126.2819	142.5977	143.6163	162.4603	174.3386	188.0072	(219)
Water heating fuel used												1920.7678	(219)
Annual totals kWh/year													
Space heating fuel - main system												2620.4113	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3660.9742	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2620.4113	10.2300	268.0681	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1920.7678	10.2300	196.4945	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			244.3514	(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	2620.4113	0.2160	566.0088	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.7678	0.2160	414.8858	(264)
Space and water heating			980.8947	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			524.0684	(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	2620.4113	1.2200	3196.9017	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.7678	1.2200	2343.3367	(264)
Space and water heating			5540.2384	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2838.0097	(272)
Primary energy kWh/m2/year			30.1916	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 85	-192 kg (36.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.04 kg/m²	A 93	A 95
Total Savings	£85	2.04 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£179	£198	-£18
Mains gas	£568	£465	£103
Space heating	£399	£399	£0
Water heating	£196	£112	£85
Lighting	£152	£152	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£244	£160	£85
Total cost of uses	£244	£160	£85
Delivered energy	39 kWh/m²	29 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	30 kWh/m²	19 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			3.2500	
Infiltration rate			0.2860	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2645	(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	0.3373	0.3306	0.3240	0.2910	0.2844	0.2513	0.2513	0.2447	0.2645	0.2844	0.2976	0.3108	(22b)
Effective ac	0.5569	0.5547	0.5525	0.5423	0.5404	0.5316	0.5316	0.5299	0.5350	0.5404	0.5443	0.5483	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.6536	44.4766	44.3030	43.4877	43.3352	42.6251	42.6251	42.4936	42.8986	43.3352	43.6437	43.9664	(38)
Heat transfer coeff	105.1343	104.9572	104.7837	103.9684	103.8158	103.1058	103.1058	102.9743	103.3793	103.8158	104.1244	104.4470	(39)
Average = Sum(39)m / 12 =												103.9677	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1185	1.1166	1.1147	1.1060	1.1044	1.0969	1.0969	1.0955	1.0998	1.1044	1.1077	1.1111	(40)
HLP (average)												1.1060	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)

Distribution loss (46)m = 0.15 x (45)m

	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273 (61)

Total heat required for water heating calculated for each month

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (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	1.1790 (H8)
Utilisation factor	0.5718 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	97.7695 (H14)
Volume ratio Veff/V	0.7671 (H15)
Solar storage volume factor	0.9470 (H16)
Solar input	-863.5142 (H17)

Solar input

	-25.0402	-41.7849	-71.1644	-95.3744	-117.8270	-115.8427	-114.3118	-99.8748	-78.2220	-53.4164	-29.7013	-20.9544 (63)

Solar input (sum of months) = Sum(63)m = -863.5142 (63)

Output from w/h

	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288 (64)

Total per year (kWh/year) = Sum(64)m = 844.3846 (64)

Heat gains from water heating, kWh/month

	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363 (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)

	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644 (71)

Water heating gains (Table 5)

	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747 (72)

Total internal gains

	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618 (73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384 (83)
Total gains	750.8517	848.7034	928.0618	997.6764	1036.0449	1008.1586	965.3792	915.9581	866.8875	793.4307	731.0338	713.4002 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7531	35.8134	35.8727	36.1540	36.2071	36.4565	36.4565	36.5030	36.3600	36.2071	36.0998	35.9883	
alpha	3.3835	3.3876	3.3915	3.4103	3.4138	3.4304	3.4304	3.4335	3.4240	3.4138	3.4067	3.3992	
util living area	0.9669	0.9492	0.9174	0.8534	0.7454	0.5922	0.4506	0.4897	0.6935	0.8754	0.9492	0.9716	(86)
MIT	19.4386	19.6586	19.9861	20.3814	20.7059	20.9041	20.9715	20.9617	20.8291	20.4138	19.8542	19.3871	(87)
Th 2	19.9858	19.9873	19.9888	19.9959	19.9972	20.0034	20.0034	20.0045	20.0010	19.9972	19.9945	19.9917	(88)
util rest of house	0.9607	0.9400	0.9021	0.8258	0.6975	0.5178	0.3562	0.3942	0.6243	0.8459	0.9383	0.9663	(89)
MIT 2	17.9255	18.2415	18.7079	19.2612	19.6879	19.9249	19.9877	19.9819	19.8474	19.3185	18.5319	17.8554	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.1991	18.4978	18.9391	19.4638	19.8720	20.1020	20.1656	20.1591	20.0249	19.5166	18.7710	18.1324	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0491	18.3478	18.7891	19.3138	19.7220	19.9520	20.0156	20.0091	19.8749	19.3666	18.6210	17.9824	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9445	0.9203	0.8794	0.8038	0.6829	0.5137	0.3574	0.3946	0.6147	0.8233	0.9185	0.9514	(94)
Useful gains	709.1532	781.0362	816.1450	801.9142	707.4854	517.8695	345.0533	361.4821	532.8634	653.2426	671.4890	678.7261	(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													
	1445.5046	1411.4408	1287.6960	1082.7022	832.8140	551.8225	352.1710	371.6461	597.0097	910.1138	1199.6187	1439.5306	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	547.8454	423.6319	350.8339	202.1673	93.2444	0.0000	0.0000	0.0000	0.0000	191.1121	380.2534	566.0385	(98)
Space heating												2755.1271	(98)
Space heating per m2											(98) / (4) =	29.3099	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3044.3393	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	547.8454	423.6319	350.8339	202.1673	93.2444	0.0000	0.0000	0.0000	0.0000	191.1121	380.2534	566.0385	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	605.3541	468.1015	387.6618	223.3893	103.0325	0.0000	0.0000	0.0000	0.0000	211.1736	420.1695	625.4569	(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													
	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7977	89.8191	89.8463	89.9140	90.0013	87.3000	87.3000	87.3000	87.3000	89.4428	89.6809	89.8190	(217)
Fuel for water heating, kWh/month													
	165.4690	122.9858	96.6954	48.6219	18.4516	1.8276	0.0000	28.1936	54.0149	101.6877	140.7054	164.3626	(219)
Water heating fuel used												943.0157	(219)
Annual totals kWh/year													
Space heating fuel - main system												3044.3393	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3307.5702	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3044.3393	3.4800	105.9430	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	943.0157	3.4800	32.8169	(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	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			169.0963	(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] =	0.5109	(257)
SAP value	92.8724	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3044.3393	0.2160	657.5773	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	943.0157	0.2160	203.6914	(264)
Space and water heating			861.2687	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			508.4604	(272)
CO2 emissions per m2			5.4100	(273)
EI value			95.0983	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				3.2500	
Infiltration rate				0.2860	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2645	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.2777	0.2579	0.2645	0.2513	0.2513	0.2447	0.2381	0.2315	0.2248	0.2447	0.2315	0.2447	(22b)
Effective ac	0.5386	0.5333	0.5350	0.5316	0.5316	0.5299	0.5283	0.5268	0.5253	0.5299	0.5268	0.5299	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1861	42.7601	42.8986	42.6251	42.6251	42.4936	42.3656	42.2411	42.1201	42.4936	42.2411	42.4936	(38)
Heat transfer coeff	103.6668	103.2408	103.3793	103.1058	103.1058	102.9743	102.8463	102.7218	102.6008	102.9743	102.7218	102.9743	(39)
Average = Sum(39)m / 12 =												103.0260	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1028	1.0983	1.0998	1.0969	1.0969	1.0955	1.0941	1.0928	1.0915	1.0955	1.0928	1.0955	(40)
HLP (average)												1.0960	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

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Energy content (annual)                                                                          Total = Sum(45)m =   1538.2950 (45)
Distribution loss  (46)m = 0.15 x (45)m
              23.9232    20.9234    21.5911    18.8236    18.0617    15.5859    14.4426    16.5731    16.7711    19.5451    21.3350    23.1684 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1393    12.7601    14.1011    13.6014    14.0221    13.5322    13.9599    14.0003    13.5699    14.0684    13.6542    14.1273 (61)
Total heat required for water heating calculated for each month
             173.6276   152.2495   158.0417   139.0923   134.4337   117.4382   110.2441   124.4878   125.3770   144.3688   155.8872   168.5831 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3194 (H8)
Utilisation factor                                                                                                                  0.5313 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             97.7695 (H14)
Volume ratio Veff/V                                                                                                                 0.7671 (H15)
Solar storage volume factor                                                                                                         0.9470 (H16)
Solar input                                                                                                                      -898.0119 (H17)
Solar input    -29.2953   -41.6561   -71.5968   -96.6006  -113.4633  -121.1967  -118.6479  -106.1935   -83.1422   -57.4816   -34.6486   -24.0893 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -898.0119 (63)
Output from w/h
             144.3323   110.5935    86.4449    42.4917    20.9704     0.0000     0.0000    18.2943    42.2348    86.8872   121.2386   144.4939 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    817.9815 (64)
Heat gains from water heating, kWh/month
              56.5647    49.5703    51.3855    45.1261    43.5424    37.9318    35.5045    40.2372    40.5683    46.8420    50.7060    54.8884 (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        160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              58.5738    52.0247    42.3093    32.0309    23.9435    20.2141    21.8420    28.3911    38.1065    48.3849    56.4723    60.2017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             367.5334   371.3472   361.7365   341.2763   315.4490   291.1749   274.9584   271.1445   280.7553   301.2155   327.0428   351.3169 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363 (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)
            -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644 (71)
Water heating gains (Table 5)
              76.0278    73.7653    69.0666    62.6751    58.5247    52.6831    47.7211    54.0822    56.3449    62.9597    70.4250    73.7747 (72)
Total internal gains
             612.4034   607.4057   583.3809   546.2508   508.1856   474.3406   454.7899   463.8863   485.4752   522.8285   564.2087   595.5618 (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
-------------------------------------------------------------------------------------------------------------
Northeast                                4.1200          14.6176           0.4600           0.0000       0.7700           21.3316 (75)
Southeast                                1.5400          45.1778           0.4600           0.0000       0.7700           24.6431 (77)
Southwest                                4.4900          45.1778           0.4600           0.0000       0.7700           71.8489 (79)
Southwest                                3.3300          45.1778           0.4600           0.0000       0.7700           53.2866 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    171.1102   254.2677   367.8458   488.1156   545.3413   600.2941   569.1876   514.3050   431.0642   308.0873   205.5918   143.1222 (83)
Total gains    783.5136   861.6734   951.2267  1034.3663  1053.5269  1074.6346  1023.9775   978.1913   916.5394   830.9158   769.8005   738.6839 (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          36.2592    36.4088    36.3600    36.4565    36.4565    36.5030    36.5485    36.5928    36.6359    36.5030    36.5928    36.5030
alpha         3.4173     3.4273     3.4240     3.4304     3.4304     3.4335     3.4366     3.4395     3.4424     3.4335     3.4395     3.4335
util living area
               0.9585     0.9428     0.9035     0.8240     0.6985     0.5128     0.3820     0.3981     0.6260     0.8365     0.9316     0.9639 (86)

MIT           19.6020    19.7672    20.1040    20.4914    20.7856    20.9453    20.9849    20.9829    20.8890    20.5521    20.0402    19.5723 (87)
Th 2          19.9985    20.0022    20.0010    20.0034    20.0034    20.0045    20.0056    20.0067    20.0078    20.0045    20.0067    20.0045 (88)
util rest of house
               0.9507     0.9324     0.8858     0.7917     0.6436     0.4343     0.2888     0.3016     0.5496     0.7986     0.9169     0.9570 (89)
MIT 2         18.1689    18.4067    18.8816    19.4135    19.7898    19.9648    19.9987    19.9989    19.9163    19.5074    18.8039    18.1312 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1809 (91)
MIT           18.4281    18.6527    19.1026    19.6085    19.9699    20.1421    20.1771    20.1768    20.0922    19.6963    19.0275    18.3918 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.2781    18.5027    18.9526    19.4585    19.8199    19.9921    20.0271    20.0268    19.9422    19.5463    18.8775    18.2418 (93)
```

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9328	0.9121	0.8629	0.7714	0.6325	0.4332	0.2909	0.3037	0.5441	0.7781	0.8954	0.9402	(94)
Useful gains	730.8537	785.9016	820.8419	797.9390	666.4024	465.5689	297.8621	297.0296	498.7155	646.5502	689.3040	694.5087	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1386.8653	1363.0617	1235.6559	1026.7742	754.7251	483.1687	301.0407	300.6487	537.8586	838.8621	1127.6297	1363.5658	(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													
	488.0727	387.8516	308.6216	164.7613	65.7121	0.0000	0.0000	0.0000	0.0000	143.0800	315.5945	497.7784	(98)
Space heating												2371.4722	(98)
Space heating per m2											(98) / (4) =	25.2284	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2620.4113	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	488.0727	387.8516	308.6216	164.7613	65.7121	0.0000	0.0000	0.0000	0.0000	143.0800	315.5945	497.7784	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	539.3068	428.5653	341.0183	182.0567	72.6100	0.0000	0.0000	0.0000	0.0000	158.0995	348.7232	550.0314	(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													
	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7492	89.7699	89.7799	89.8250	89.7045	87.3000	87.3000	87.3000	87.3000	89.2638	89.5886	89.7598	(217)
Fuel for water heating, kWh/month													
	160.8174	123.1966	96.2854	47.3050	23.3772	0.0000	0.0000	20.9557	48.3790	97.3376	135.3281	160.9784	(219)
Water heating fuel used												913.9602	(219)
Annual totals kWh/year													
Space heating fuel - main system												2620.4113	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2704.1667	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2620.4113	10.2300	268.0681	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	913.9602	10.2300	93.4981	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			159.7150	(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	2620.4113	0.2160	566.0088	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.9602	0.2160	197.4154	(264)
Space and water heating			763.4242	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			332.5480 (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	2620.4113	1.2200	3196.9017	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.9602	1.2200	1115.0315	(264)
Space and water heating			4311.9332	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1763.2045	(272)
Primary energy kWh/m2/year			18.7575	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	144.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	320.75 (P1)
Transmission heat loss coefficient	60.48 (37)
Summer heat loss coefficient	381.23 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.1200	106.0502	0.4600	0.0000	0.9000	180.8877
South East	1.5400	127.3119	0.4600	0.0000	0.9000	81.1689
South West	4.4900	127.3119	0.4600	0.0000	0.9000	236.6549
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						674.2263

	Jun	Jul	Aug	
Solar gains	723	674	607	(P4)
Internal gains	471	452	461	
Total summer gains	1194	1126	1068	(P5)
Summer gain/loss ratio	3.13	2.95	2.80	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 144.0)	0.99	0.99	0.99	
Threshold temperature	19.52	21.25	21.09	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-573.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	3-OP-SEMI
Property	30, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	91 B	**DER**	9.28	**TER**	17.55
Environmental	93 A	**% DER<TER**	47.13		
CO_2 Emissions (t/year)	0.55	**DFEE**	43.91	**TFEE**	51.20
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.24		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 94 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.55 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.28 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.9 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.80 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.12 m², No overhang
Windows facing South West: 7.82 m², No overhang
Windows facing North West: 1.54 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		4.8000	
Infiltration rate		0.3635	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3362	(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	0.4287	0.4203	0.4118	0.3698	0.3614	0.3194	0.3194	0.3110	0.3362	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5919	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5484	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.4604	47.1743	46.8939	45.5769	45.3304	44.1833	44.1833	43.9709	44.6252	45.3304	45.8289	46.3501	(38)
Heat transfer coeff	107.9411	107.6550	107.3746	106.0575	105.8111	104.6640	104.6640	104.4516	105.1059	105.8111	106.3096	106.8308	(39)
Average = Sum(39)m / 12 =												106.0564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1483	1.1453	1.1423	1.1283	1.1257	1.1134	1.1134	1.1112	1.1181	1.1257	1.1310	1.1365	(40)
HLP (average)												1.1283	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	411.8538	409.5270	394.5029	370.2917	345.6020	322.0051	306.8291	313.2546	325.8427	350.2772	378.2818	399.3869	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	536.3867	629.1659	714.9793	800.8283	858.3711	844.4961	804.9773	748.0004	684.1102	598.4059	528.8118	505.0757	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8234	34.9159	35.0071	35.4418	35.5244	35.9137	35.9137	35.9868	35.7627	35.5244	35.3578	35.1853	
alpha	3.3216	3.3277	3.3338	3.3628	3.3683	3.3942	3.3942	3.3991	3.3842	3.3683	3.3572	3.3457	
util living area													
	0.9874	0.9779	0.9582	0.9117	0.8207	0.6762	0.5319	0.5828	0.7939	0.9370	0.9794	0.9896	(86)
MIT	19.0856	19.3173	19.6867	20.1635	20.5769	20.8500	20.9508	20.9324	20.7238	20.1832	19.5497	19.0463	(87)
Th 2	19.9616	19.9640	19.9665	19.9778	19.9799	19.9899	19.9899	19.9917	19.9860	19.9799	19.9756	19.9711	(88)
util rest of house													
	0.9848	0.9734	0.9493	0.8920	0.7789	0.6001	0.4250	0.4764	0.7317	0.9189	0.9744	0.9875	(89)
MIT 2	17.4015	17.7391	18.2737	18.9578	19.5200	19.8623	19.9617	19.9498	19.7237	18.9989	18.0867	17.3502	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	17.7061	18.0245	18.5293	19.1758	19.7111	20.0409	20.1406	20.1275	19.9046	19.2131	18.3513	17.6569	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5561	17.8745	18.3793	19.0258	19.5611	19.8909	19.9906	19.9775	19.7546	19.0631	18.2013	17.5069	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9756	0.9601	0.9305	0.8687	0.7588	0.5918	0.4251	0.4748	0.7149	0.8969	0.9616	0.9796	(94)
Useful gains	523.3143	604.0367	665.3238	695.6785	651.3363	499.8065	342.2202	355.1283	489.0724	536.7373	508.4854	494.7487	(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													
	1430.8771	1396.7674	1275.5329	1073.9194	831.7948	553.7704	354.8759	373.6781	594.3287	895.4865	1180.1701	1421.5893	(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													
	675.2267	532.7150	453.9956	272.3334	134.2611	0.0000	0.0000	0.0000	0.0000	266.9094	483.6130	689.5695	(98)
Space heating												3508.6238	(98)
Space heating per m2											(98) / (4) =	37.3258	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3876.9323	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	675.2267	532.7150	453.9956	272.3334	134.2611	0.0000	0.0000	0.0000	0.0000	266.9094	483.6130	689.5695	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	746.1069	588.6354	501.6526	300.9209	148.3549	0.0000	0.0000	0.0000	0.0000	294.9275	534.3790	761.9552	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8265	89.7686	89.6514	89.3922	88.8702	87.3000	87.3000	87.3000	87.3000	89.3503	89.6985	89.8530	(217)
Fuel for water heating, kWh/month													
	193.2922	169.6022	176.2846	155.5978	151.2698	134.5226	126.2819	142.5977	143.6163	161.5761	173.7902	187.6211	(219)
Water heating fuel used												1916.0523	(219)
Annual totals kWh/year													
Space heating fuel - main system												3876.9323	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5063.1999	(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	3876.9323	0.2160	837.4174	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1916.0523	0.2160	413.8673	(264)
Space and water heating			1251.2847	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			872.5264	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.2800	(273)

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

DER		9.2800	ZC1
Total Floor Area	TFA	94.0000	
Assumed number of occupants	N	2.6766	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5235	ZC2
CO2 emissions from cooking, equation (L16)		1.9493	ZC3
Total CO2 emissions		26.7529	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.7529	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8187	47.2508	46.8329	43.3936	44.8400	46.8329	47.2508	50.8187	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
								Total per year (kWh/year) = Sum(64)m =				2113.5938	(64)
Heat gains from water heating, kWh/month													
	65.7696	57.8871	60.5649	53.5384	51.7451	45.3971	43.2245	48.4453	48.9886	56.0296	59.6213	64.0963	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	88.4000	86.1415	81.4045	74.3589	69.5498	63.0516	58.0975	65.1147	68.0397	75.3085	82.8073	86.1510	(72)
Total internal gains													
	424.2260	421.9032	406.8408	381.9756	356.6272	332.3736	317.2055	324.2871	337.5375	362.6260	390.6641	411.7631	(73)

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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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)
Northwest	1.5400	11.2829	0.6300	0.7000	0.7700	5.3102	(81)

Solar gains	107.4502	189.5102	276.5154	371.4781	442.4305	450.8189	429.8152	375.1100	309.1225	214.0919	129.8812	91.1911	(83)
Total gains	531.6763	611.4134	683.3562	753.4537	799.0577	783.1925	747.0207	699.3971	646.6600	576.7180	520.5453	502.9542	(84)

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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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9985	0.9966	0.9910	0.9704	0.9052	0.7550	0.5833	0.6400	0.8747	0.9815	0.9968	0.9989	(86)
MIT	19.7658	19.9123	20.1533	20.4759	20.7622	20.9384	20.9872	20.9796	20.8578	20.4891	20.0710	19.7435	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9980	0.9954	0.9876	0.9586	0.8668	0.6675	0.4612	0.5172	0.8108	0.9720	0.9955	0.9985	(89)
MIT 2	18.3331	18.5490	18.9015	19.3728	19.7614	19.9709	20.0088	20.0069	19.8903	19.3987	18.7902	18.3078	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.5922	18.7955	19.1278	19.5723	19.9424	20.1459	20.1858	20.1828	20.0653	19.5959	19.0218	18.5675	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5922	18.7955	19.1278	19.5723	19.9424	20.1459	20.1858	20.1828	20.0653	19.5959	19.0218	18.5675	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9934	0.9837	0.9520	0.8640	0.6803	0.4833	0.5392	0.8151	0.9666	0.9935	0.9977	(94)
Useful gains	530.0258	607.3486	672.1920	717.3106	690.3757	532.8073	361.0701	377.1172	527.0663	557.4690	517.1633	501.7737	(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													
	1505.9838	1459.9856	1323.0535	1103.3226	849.9760	565.1857	365.4296	384.6641	610.7091	927.6789	1235.6731	1497.0686	(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													
	726.1127	572.9721	484.2410	277.9286	118.7426	0.0000	0.0000	0.0000	0.0000	275.4362	517.3271	740.4994	(98)
Space heating												3713.2597	(98)
Space heating per m2											(98) / (4) =	39.5028	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3975.6528	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1127	572.9721	484.2410	277.9286	118.7426	0.0000	0.0000	0.0000	0.0000	275.4362	517.3271	740.4994	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	777.4226	613.4605	518.4593	297.5681	127.1334	0.0000	0.0000	0.0000	0.0000	294.8995	553.8834	792.8259	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9153	87.7020	87.2522	86.2422	84.2062	80.3000	80.3000	80.3000	80.3000	86.1037	87.4286	87.9965	(217)
Fuel for water heating, kWh/month													
	239.3750	211.5311	223.2143	200.2984	198.6130	183.4366	175.7462	195.9159	198.0796	210.3500	219.0910	233.4353	(219)
Water heating fuel used												2489.0864	(219)
Annual totals kWh/year													
Space heating fuel - main system												3975.6528	(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)												413.7723	(232)
Total delivered energy for all uses												6953.5115	(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	3975.6528	0.2160	858.7410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2489.0864	0.2160	537.6427	(264)
Space and water heating			1396.3837	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Total CO2, kg/m2/year			1650.0565	(272)
Emissions per m2 for space and water heating			14.8551	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2846	(272b)
Emissions per m2 for pumps and fans			0.4141	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8551 * 1.00) + 2.2846 + 0.4141, rounded to 2 d.p.			17.5500	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				4.8000	
Infiltration rate				0.3635	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3362	(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	0.4287	0.4203	0.4118	0.3698	0.3614	0.3194	0.3194	0.3110	0.3362	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5919	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5484	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.4604	47.1743	46.8939	45.5769	45.3304	44.1833	44.1833	43.9709	44.6252	45.3304	45.8289	46.3501	(38)
Heat transfer coeff	107.9411	107.6550	107.3746	106.0575	105.8111	104.6640	104.6640	104.4516	105.1059	105.8111	106.3096	106.8308	(39)
Average = Sum(39)m / 12 =												106.0564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1483	1.1453	1.1423	1.1283	1.1257	1.1134	1.1134	1.1112	1.1181	1.1257	1.1310	1.1365	(40)
HLP (average)												1.1283	(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	2.6766	(42)
Average daily hot water use (litres/day)	97.7695	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	502.9117	596.5100	684.0248	772.1904	831.2381	819.4798	781.7567	722.4755	657.7639	569.6624	497.3652	472.4164	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8234	34.9159	35.0071	35.4418	35.5244	35.9137	35.9137	35.9868	35.7627	35.5244	35.3578	35.1853	
alpha	3.3216	3.3277	3.3338	3.3628	3.3683	3.3942	3.3942	3.3991	3.3842	3.3683	3.3572	3.3457	
util living area													
	0.9896	0.9810	0.9628	0.9190	0.8314	0.6893	0.5446	0.5983	0.8080	0.9444	0.9827	0.9915	(86)
MIT	19.0376	19.2720	19.6468	20.1325	20.5566	20.8406	20.9472	20.9267	20.7062	20.1488	19.5057	18.9989	(87)
Th 2	19.9616	19.9640	19.9665	19.9778	19.9799	19.9899	19.9899	19.9917	19.9860	19.9799	19.9756	19.9711	(88)
util rest of house													
	0.9874	0.9770	0.9548	0.9005	0.7909	0.6135	0.4363	0.4908	0.7477	0.9280	0.9785	0.9897	(89)
MIT 2	18.1661	18.4004	18.7721	19.2527	19.6490	19.8966	19.9691	19.9604	19.7937	19.2780	18.6427	18.1346	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.3237	18.5580	18.9303	19.4118	19.8132	20.0674	20.1460	20.1352	19.9587	19.4355	18.7987	18.2909	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3237	18.5580	18.9303	19.4118	19.8132	20.0674	20.1460	20.1352	19.9587	19.4355	18.7987	18.2909	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9699	0.9444	0.8881	0.7833	0.6198	0.4541	0.5072	0.7458	0.9168	0.9718	0.9857	(94)
Useful gains	494.1962	578.5356	646.0179	685.7481	651.1431	507.9420	354.9729	366.4712	490.5740	522.2660	483.3471	465.6607	(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													
	1513.7303	1470.3527	1334.7011	1114.8556	858.4639	572.2360	371.1348	390.1447	615.7862	934.8921	1243.6895	1505.3423	(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													
	758.5333	599.3011	512.3803	308.9574	154.2467	0.0000	0.0000	0.0000	0.0000	306.9938	547.4465	773.5231	(98)
Space heating												3961.3822	(98)
Space heating per m2											(98) / (4) =	42.1424	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	983.8416	774.5136	793.8319	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8003	0.8636	0.8353	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	787.4035	668.8401	663.1236	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1060.0280	1013.8205	946.5058	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	196.2896	256.6654	210.8363	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												663.7914	(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	49.0724	64.1664	52.7091	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												165.9478	(107)
Space cooling per m2												1.7654	(108)
Energy for space heating												42.1424	(99)
Energy for space cooling												1.7654	(108)
Total												43.9078	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.9	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)
Northwest	1.5400	11.2829	0.6300	0.7000	0.7700	5.3102	(81)

Solar gains	107.4502	189.5102	276.5154	371.4781	442.4305	450.8189	429.8152	375.1100	309.1225	214.0919	129.8812	91.1911	(83)
Total gains	485.8290	566.3813	640.0638	713.1320	760.8996	747.8076	713.4238	662.8397	608.6189	535.6256	476.7165	457.9187	(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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9990	0.9976	0.9932	0.9763	0.9191	0.7780	0.6072	0.6686	0.8955	0.9865	0.9979	0.9993	(86)
MIT	19.7200	19.8678	20.1116	20.4407	20.7380	20.9288	20.9846	20.9751	20.8370	20.4511	20.0275	19.6984	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9987	0.9968	0.9907	0.9665	0.8844	0.6920	0.4819	0.5434	0.8375	0.9793	0.9970	0.9990	(89)
MIT 2	18.8112	18.9607	19.2054	19.5388	19.8183	19.9792	20.0097	20.0082	19.9135	19.5542	19.1303	18.7977	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.9755	19.1247	19.3693	19.7019	19.9847	20.1509	20.1860	20.1831	20.0805	19.7164	19.2926	18.9606	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9755	19.1247	19.3693	19.7019	19.9847	20.1509	20.1860	20.1831	20.0805	19.7164	19.2926	18.9606	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9958	0.9886	0.9628	0.8836	0.7053	0.5048	0.5661	0.8425	0.9765	0.9961	0.9987	(94)
Useful gains	484.9510	563.9797	632.7612	686.5760	672.3593	527.3947	360.1221	375.2478	512.7727	523.0198	474.8435	457.3108	(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													
	1546.3727	1494.5753	1348.3506	1116.7220	854.3302	565.7001	365.4494	384.6857	612.2651	940.0989	1263.7378	1538.0315	(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													
	789.6977	625.3602	532.3985	309.7051	135.3863	0.0000	0.0000	0.0000	0.0000	310.3069	568.0038	804.0562	(98)
Space heating												4074.9148	(98)
Space heating per m2											(98) / (4) =	43.3502	(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	957.9624	754.1406	772.8182	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8484	0.9155	0.8887	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	812.6951	690.4309	686.8397	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	976.2554	933.9508	876.8016	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	117.7634	181.1788	141.3317	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												440.2739	(104)

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	29.4409	45.2947	35.3329	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												110.0685 (107)
Space cooling per m2												1.1709 (108)
Energy for space heating												43.3502 (99)
Energy for space cooling												1.1709 (108)
Total												44.5211 (109)
Target Fabric Energy Efficiency (TFEE)												51.2 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3635	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3362	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3530	0.3278	0.3362	0.3194	0.3194	0.3110	0.3026	0.2942	0.2858	0.3110	0.2942	0.3110	(22b)
Effective ac	0.5623	0.5537	0.5565	0.5510	0.5510	0.5484	0.5458	0.5433	0.5408	0.5484	0.5433	0.5484	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(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	45.0897	44.4014	44.6252	44.1833	44.1833	43.9709	43.7641	43.5630	43.3676	43.9709	43.5630	43.9709	(38)
Heat transfer coeff	105.5704	104.8821	105.1059	104.6640	104.6640	104.4516	104.2448	104.0437	103.8483	104.4516	104.0437	104.4516	(39)
Average = Sum(39)m / 12 =												104.5351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1158	1.1181	1.1134	1.1134	1.1112	1.1090	1.1068	1.1048	1.1112	1.1068	1.1112	(40)
HLP (average)												1.1121	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m
23.9232 20.9234 21.5911 18.8236 18.0617 15.5859 14.4426 16.5731 16.7711 19.5451 21.3350 23.1684 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 14.1393 12.7601 14.1011 13.6014 14.0221 13.5322 13.9599 14.0003 13.5699 14.0684 13.6542 14.1273 (61)
Total heat required for water heating calculated for each month
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (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
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (64)
Total per year (kWh/year) = Sum(64)m = 1703.8311 (64)
RHI water heating demand 1704 (64)
Heat gains from water heating, kWh/month
56.5647 49.5703 51.3855 45.1261 43.5424 37.9318 35.5045 40.2372 40.5683 46.8420 50.7060 54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Northwest	1.5400	14.6176	0.4600	0.0000	0.7700	7.9735	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	154.4406	232.4625	343.8604	468.0336	532.1462	589.8722	557.6542	497.1084	407.1536	283.8700	186.1997	128.7709	(83)
Total gains	766.8440	839.8682	927.2413	1014.2844	1040.3318	1064.2128	1012.4441	960.9947	892.6288	806.6985	750.4084	724.3327	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6054	35.8390	35.7627	35.9137	35.9137	35.9868	36.0581	36.1278	36.1958	35.9868	36.1278	35.9868	
alpha	3.3737	3.3893	3.3842	3.3942	3.3942	3.3991	3.4039	3.4085	3.4131	3.3991	3.4085	3.3991	
util living area													
	0.9614	0.9472	0.9107	0.8335	0.7087	0.5223	0.3906	0.4090	0.6421	0.8485	0.9367	0.9661	(86)
MIT	19.5425	19.7086	20.0492	20.4561	20.7686	20.9400	20.9831	20.9807	20.8766	20.5164	19.9959	19.5241	(87)
Th 2	19.9820	19.9880	19.9860	19.9899	19.9899	19.9917	19.9935	19.9952	19.9969	19.9917	19.9952	19.9917	(88)
util rest of house													
	0.9540	0.9374	0.8939	0.8020	0.6537	0.4421	0.2945	0.3093	0.5649	0.8120	0.9228	0.9595	(89)
MIT 2	18.0732	18.3141	18.7954	19.3573	19.7588	19.9481	19.9858	19.9864	19.8947	19.4523	18.7343	18.0538	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3390	18.5663	19.0222	19.5560	19.9414	20.1275	20.1662	20.1662	20.0723	19.6448	18.9625	18.3197	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1890	18.4163	18.8722	19.4060	19.7914	19.9775	20.0162	20.0162	19.9223	19.4948	18.8125	18.1697	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9174	0.8708	0.7808	0.6418	0.4409	0.2967	0.3115	0.5586	0.7905	0.9015	0.9431	(94)
Useful gains	718.0611	770.4841	807.4481	791.9894	667.6395	469.1994	300.4369	299.3052	498.6262	637.6824	676.4666	683.1211	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1402.9204	1375.6620	1247.8327	1036.8045	763.1503	488.5718	303.9969	303.4105	542.3242	845.5110	1135.3756	1375.5934	(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													
	509.5353	406.6795	327.6461	176.2669	71.0600	0.0000	0.0000	0.0000	0.0000	154.6245	330.4144	515.1994	(98)
Space heating												2491.4262	(98)
RHI space heating demand												2491	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3635	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3362	(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	0.4287	0.4203	0.4118	0.3698	0.3614	0.3194	0.3194	0.3110	0.3362	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5919	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5484	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.4604	47.1743	46.8939	45.5769	45.3304	44.1833	44.1833	43.9709	44.6252	45.3304	45.8289	46.3501	(38)
Heat transfer coeff	107.9411	107.6550	107.3746	106.0575	105.8111	104.6640	104.6640	104.4516	105.1059	105.8111	106.3096	106.8308	(39)
Average = Sum(39)m / 12 =												106.0564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1483	1.1453	1.1423	1.1283	1.1257	1.1134	1.1134	1.1112	1.1181	1.1257	1.1310	1.1365	(40)
HLP (average)												1.1283	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	736.9364	827.0446	903.8573	976.7873	1020.9546	996.8316	952.9381	898.6321	843.7426	770.9572	714.7386	701.2506	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8234	34.9159	35.0071	35.4418	35.5244	35.9137	35.9137	35.9868	35.7627	35.5244	35.3578	35.1853	
alpha	3.3216	3.3277	3.3338	3.3628	3.3683	3.3942	3.3942	3.3991	3.3842	3.3683	3.3572	3.3457	
util living area													
	0.9691	0.9535	0.9244	0.8629	0.7567	0.6027	0.4612	0.5030	0.7104	0.8855	0.9529	0.9733	(86)
MIT	19.3631	19.5782	19.9133	20.3341	20.6799	20.8952	20.9681	20.9568	20.8092	20.3678	19.7963	19.3219	(87)
Th 2	19.9616	19.9640	19.9665	19.9778	19.9799	19.9899	19.9899	19.9917	19.9860	19.9799	19.9756	19.9711	(88)
util rest of house													
	0.9632	0.9449	0.9100	0.8362	0.7090	0.5272	0.3640	0.4047	0.6412	0.8573	0.9427	0.9682	(89)
MIT 2	17.8015	18.1117	18.5909	19.1847	19.6424	19.9040	19.9723	19.9662	19.8135	19.2452	18.4374	17.7484	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.0839	18.3770	18.8301	19.3926	19.8300	20.0832	20.1524	20.1453	19.9936	19.4482	18.6832	18.0329	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9339	18.2270	18.6801	19.2426	19.6800	19.9332	20.0024	19.9953	19.8436	19.2982	18.5332	17.8829	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9472	0.9254	0.8871	0.8133	0.6932	0.5226	0.3653	0.4051	0.6303	0.8341	0.9231	0.9535	(94)
Useful gains	697.9907	765.3399	801.8099	794.4125	707.7276	520.9703	348.1080	364.0292	531.8045	643.0358	659.7727	668.6640	(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													
	1471.6566	1434.7140	1307.8307	1096.9065	844.3752	558.1974	356.1095	375.5396	603.6847	920.3659	1215.4579	1461.7601	(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													
	575.6074	449.8194	376.4795	217.7956	101.6658	0.0000	0.0000	0.0000	0.0000	206.3336	400.0934	590.0635	(98)
Space heating												2917.8581	(98)
Space heating per m2											(98) / (4) =	31.0410	(99)

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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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3224.1526	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	575.6074	449.8194	376.4795	217.7956	101.6658	0.0000	0.0000	0.0000	0.0000	206.3336	400.0934	590.0635	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	636.0303	497.0380	415.9994	240.6582	112.3379	0.0000	0.0000	0.0000	0.0000	227.9929	442.0921	652.0039	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7377	89.6688	89.5297	89.2253	88.6498	87.3000	87.3000	87.3000	87.3000	89.1547	89.5794	89.7688	(217)
Fuel for water heating, kWh/month													
	193.4834	169.7909	176.5244	155.8888	151.6459	134.5226	126.2819	142.5977	143.6163	161.9306	174.0214	187.7970	(219)
Water heating fuel used												1918.1008	(219)
Annual totals kWh/year													
Space heating fuel - main system												3224.1526	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4412.4687	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3224.1526	3.4800	112.2005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1918.1008	3.4800	66.7499	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			202.6918	(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] =	0.6125	(257)
SAP value		91.4563	
SAP rating (Section 12)		91	(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	3224.1526	0.2160	696.4170	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1918.1008	0.2160	414.3098	(264)
Space and water heating			1110.7267	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			731.9685	(272)
CO2 emissions per m2			7.7900	(273)
EI value			92.9436	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8871 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8871 = 0.2435, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3635	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3362	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3530	0.3278	0.3362	0.3194	0.3194	0.3110	0.3026	0.2942	0.2858	0.3110	0.2942	0.3110	(22b)
Effective ac	0.5623	0.5537	0.5565	0.5510	0.5510	0.5484	0.5458	0.5433	0.5408	0.5484	0.5433	0.5484	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (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	45.0897	44.4014	44.6252	44.1833	44.1833	43.9709	43.7641	43.5630	43.3676	43.9709	43.5630	43.9709	(38)
Heat transfer coeff	105.5704	104.8821	105.1059	104.6640	104.6640	104.4516	104.2448	104.0437	103.8483	104.4516	104.0437	104.4516	(39)
Average = Sum(39)m / 12 =												104.5351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1158	1.1181	1.1134	1.1134	1.1112	1.1090	1.1068	1.1048	1.1112	1.1068	1.1112	(40)
HLP (average)												1.1121	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Northwest	1.5400	14.6176	0.4600	0.0000	0.7700	7.9735	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	154.4406	232.4625	343.8604	468.0336	532.1462	589.8722	557.6542	497.1084	407.1536	283.8700	186.1997	128.7709	(83)
Total gains	766.8440	839.8682	927.2413	1014.2844	1040.3318	1064.2128	1012.4441	960.9947	892.6288	806.6985	750.4084	724.3327	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6054	35.8390	35.7627	35.9137	35.9137	35.9868	36.0581	36.1278	36.1958	35.9868	36.1278	35.9868	
alpha	3.3737	3.3893	3.3842	3.3942	3.3942	3.3991	3.4039	3.4085	3.4131	3.3991	3.4085	3.3991	
util living area													
	0.9614	0.9472	0.9107	0.8335	0.7087	0.5223	0.3906	0.4090	0.6421	0.8485	0.9367	0.9661	(86)
MIT	19.5425	19.7086	20.0492	20.4561	20.7686	20.9400	20.9831	20.9807	20.8766	20.5164	19.9959	19.5241	(87)
Th 2	19.9820	19.9880	19.9860	19.9899	19.9899	19.9917	19.9935	19.9952	19.9969	19.9917	19.9952	19.9917	(88)
util rest of house													
	0.9540	0.9374	0.8939	0.8020	0.6537	0.4421	0.2945	0.3093	0.5649	0.8120	0.9228	0.9595	(89)
MIT 2	18.0732	18.3141	18.7954	19.3573	19.7588	19.9481	19.9858	19.9864	19.8947	19.4523	18.7343	18.0538	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3390	18.5663	19.0222	19.5560	19.9414	20.1275	20.1662	20.1662	20.0723	19.6448	18.9625	18.3197	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1890	18.4163	18.8722	19.4060	19.7914	19.9775	20.0162	20.0162	19.9223	19.4948	18.8125	18.1697	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9174	0.8708	0.7808	0.6418	0.4409	0.2967	0.3115	0.5586	0.7905	0.9015	0.9431	(94)
Useful gains	718.0611	770.4841	807.4481	791.9894	667.6395	469.1994	300.4369	299.3052	498.6262	637.6824	676.4666	683.1211	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1402.9204	1375.6620	1247.8327	1036.8045	763.1503	488.5718	303.9969	303.4105	542.3242	845.5110	1135.3756	1375.5934	(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													
	509.5353	406.6795	327.6461	176.2669	71.0600	0.0000	0.0000	0.0000	0.0000	154.6245	330.4144	515.1994	(98)
Space heating												2491.4262	(98)
Space heating per m2											(98) / (4) =	26.5045	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2752.9571	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	509.5353	406.6795	327.6461	176.2669	71.0600	0.0000	0.0000	0.0000	0.0000	154.6245	330.4144	515.1994	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	563.0224	449.3697	362.0399	194.7700	78.5194	0.0000	0.0000	0.0000	0.0000	170.8557	365.0988	569.2811	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6647	89.6053	89.4333	89.0602	88.3807	87.3000	87.3000	87.3000	87.3000	88.9261	89.4490	89.6895	(217)
Fuel for water heating, kWh/month													
	193.6410	169.9113	176.7146	156.1779	152.1076	134.5226	126.2819	142.5977	143.6163	162.3469	174.2750	187.9632	(219)
Water heating fuel used												1920.1561	(219)
Annual totals kWh/year													
Space heating fuel - main system												2752.9571	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3792.9083	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2752.9571	10.2300	281.6275	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1920.1561	10.2300	196.4320	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			257.8483	(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	2752.9571	0.2160	594.6387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.1561	0.2160	414.7537	(264)
Space and water heating			1009.3924	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			552.5662	(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	2752.9571	1.2200	3358.6077	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.1561	1.2200	2342.5904	(264)
Space and water heating			5701.1980	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2998.9693	(272)
Primary energy kWh/m2/year			31.9039	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 85	-191 kg (34.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.04 kg/m²	A 93	A 95
Total Savings	£85	2.04 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£179	£198	-£18
Mains gas	£581	£478	£103
Space heating	£412	£412	£0
Water heating	£196	£112	£85
Lighting	£152	£152	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£257	£173	£85
Total cost of uses	£257	£173	£85
Delivered energy	40 kWh/m²	30 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	32 kWh/m²	20 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				4.8000	
Infiltration rate				0.3635	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3362	(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	0.4287	0.4203	0.4118	0.3698	0.3614	0.3194	0.3194	0.3110	0.3362	0.3614	0.3782	0.3950	(22b)
Effective ac	0.5919	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5484	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.4604	47.1743	46.8939	45.5769	45.3304	44.1833	44.1833	43.9709	44.6252	45.3304	45.8289	46.3501	(38)
Heat transfer coeff	107.9411	107.6550	107.3746	106.0575	105.8111	104.6640	104.6640	104.4516	105.1059	105.8111	106.3096	106.8308	(39)
Average = Sum(39)m / 12 =												106.0564	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1483	1.1453	1.1423	1.1283	1.1257	1.1134	1.1134	1.1112	1.1181	1.1257	1.1310	1.1365	(40)
HLP (average)												1.1283	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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												1.1790	(H8)
Utilisation factor												0.5718	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												97.7695	(H14)
Volume ratio Veff/V												0.7671	(H15)
Solar storage volume factor												0.9470	(H16)
Solar input												-863.5142	(H17)
Solar input	-25.0402	-41.7849	-71.1644	-95.3744	-117.8270	-115.8427	-114.3118	-99.8748	-78.2220	-53.4164	-29.7013	-20.9544	(63)
										Solar input (sum of months) = Sum(63)m =		-863.5142	(63)
Output from w/h													
	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288	(64)
										Total per year (kWh/year) = Sum(64)m =		844.3846	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	736.9364	827.0446	903.8573	976.7873	1020.9546	996.8316	952.9381	898.6321	843.7426	770.9572	714.7386	701.2506	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8234	34.9159	35.0071	35.4418	35.5244	35.9137	35.9137	35.9868	35.7627	35.5244	35.3578	35.1853	
alpha	3.3216	3.3277	3.3338	3.3628	3.3683	3.3942	3.3942	3.3991	3.3842	3.3683	3.3572	3.3457	
util living area													
	0.9691	0.9535	0.9244	0.8629	0.7567	0.6027	0.4612	0.5030	0.7104	0.8855	0.9529	0.9733	(86)
MIT	19.3631	19.5782	19.9133	20.3341	20.6799	20.8952	20.9681	20.9568	20.8092	20.3678	19.7963	19.3219	(87)
Th 2	19.9616	19.9640	19.9665	19.9778	19.9799	19.9899	19.9899	19.9917	19.9860	19.9799	19.9756	19.9711	(88)
util rest of house													
	0.9632	0.9449	0.9100	0.8362	0.7090	0.5272	0.3640	0.4047	0.6412	0.8573	0.9427	0.9682	(89)
MIT 2	17.8015	18.1117	18.5909	19.1847	19.6424	19.9040	19.9723	19.9662	19.8135	19.2452	18.4374	17.7484	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.0839	18.3770	18.8301	19.3926	19.8300	20.0832	20.1524	20.1453	19.9936	19.4482	18.6832	18.0329	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9339	18.2270	18.6801	19.2426	19.6800	19.9332	20.0024	19.9953	19.8436	19.2982	18.5332	17.8829	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9472	0.9254	0.8871	0.8133	0.6932	0.5226	0.3653	0.4051	0.6303	0.8341	0.9231	0.9535	(94)
Useful gains	697.9907	765.3399	801.8099	794.4125	707.7276	520.9703	348.1080	364.0292	531.8045	643.0358	659.7727	668.6640	(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	1471.6566	1434.7140	1307.8307	1096.9065	844.3752	558.1974	356.1095	375.5396	603.6847	920.3659	1215.4579	1461.7601	(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	575.6074	449.8194	376.4795	217.7956	101.6658	0.0000	0.0000	0.0000	0.0000	206.3336	400.0934	590.0635	(98)
Space heating												2917.8581	(98)
Space heating per m2											(98) / (4) =	31.0410	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3224.1526	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	575.6074	449.8194	376.4795	217.7956	101.6658	0.0000	0.0000	0.0000	0.0000	206.3336	400.0934	590.0635	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	636.0303	497.0380	415.9994	240.6582	112.3379	0.0000	0.0000	0.0000	0.0000	227.9929	442.0921	652.0039	(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	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8245	89.8507	89.8823	89.9488	90.0366	87.3000	87.3000	87.3000	87.3000	89.4964	89.7115	89.8410	(217)
Fuel for water heating, kWh/month	165.4198	122.9425	96.6567	48.6031	18.4444	1.8276	0.0000	28.1936	54.0149	101.6269	140.6574	164.3223	(219)
Water heating fuel used												942.7094	(219)

Annual totals kWh/year		
Space heating fuel - main system	3224.1526	(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)	413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571	-1218.5571	(233)
Total delivered energy for all uses	3487.0772	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3224.1526	3.4800	112.2005	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	942.7094	3.4800	32.8063	(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	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			175.3432	(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] =	0.5298	(257)
SAP value	92.6091	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3224.1526	0.2160	696.4170	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	942.7094	0.2160	203.6252	(264)
Space and water heating			900.0422	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			547.2339	(272)
CO2 emissions per m2			5.8200	(273)
EI value			94.7245	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.8000	
Infiltration rate			0.3635	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3362	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3530	0.3278	0.3362	0.3194	0.3194	0.3110	0.3026	0.2942	0.2858	0.3110	0.2942	0.3110	(22b)
Effective ac	0.5623	0.5537	0.5565	0.5510	0.5510	0.5484	0.5458	0.5433	0.5408	0.5484	0.5433	0.5484	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(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	45.0897	44.4014	44.6252	44.1833	44.1833	43.9709	43.7641	43.5630	43.3676	43.9709	43.5630	43.9709	(38)
Heat transfer coeff	105.5704	104.8821	105.1059	104.6640	104.6640	104.4516	104.2448	104.0437	103.8483	104.4516	104.0437	104.4516	(39)
Average = Sum(39)m / 12 =												104.5351	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1158	1.1181	1.1134	1.1134	1.1112	1.1090	1.1068	1.1048	1.1112	1.1068	1.1112	(40)
HLP (average)												1.1121	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

```
Energy content (annual)                                                                          Total = Sum(45)m =   1538.2950 (45)
Distribution loss  (46)m = 0.15 x (45)m
              23.9232    20.9234    21.5911    18.8236    18.0617    15.5859    14.4426    16.5731    16.7711    19.5451    21.3350    23.1684 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1393    12.7601    14.1011    13.6014    14.0221    13.5322    13.9599    14.0003    13.5699    14.0684    13.6542    14.1273 (61)
Total heat required for water heating calculated for each month
             173.6276   152.2495   158.0417   139.0923   134.4337   117.4382   110.2441   124.4878   125.3770   144.3688   155.8872   168.5831 (62)
Aperture area of solar collector                                                                                                    3.0000 (H1)
Zero-loss collector efficiency                                                                                                      0.7000 (H2)
Collector heat loss coefficient                                                                                                     1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                           0.0050 (H3a)
Collector effective heat loss coefficient                                                                                           1.8063 (H3b)
Collector performance ratio                                                                                                         2.5804 (H4)
Annual solar radiation per m2                                                                                                    1208.1510 (H5)
Overshading factor                                                                                                                  0.8000 (H6)
Solar energy available                                                                                                           2029.6937 (H7)
Adjustment factor for showers                                                                                                       1.0000 (H7a)
Solar-to-load ratio                                                                                                                 1.3194 (H8)
Utilisation factor                                                                                                                  0.5313 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             97.7695 (H14)
Volume ratio Veff/V                                                                                                                 0.7671 (H15)
Solar storage volume factor                                                                                                         0.9470 (H16)
Solar input                                                                                                                      -898.0119 (H17)
Solar input    -29.2953   -41.6561   -71.5968   -96.6006  -113.4633  -121.1967  -118.6479  -106.1935   -83.1422   -57.4816   -34.6486   -24.0893 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -898.0119 (63)
Output from w/h
             144.3323   110.5935    86.4449    42.4917    20.9704     0.0000     0.0000    18.2943    42.2348    86.8872   121.2386   144.4939 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =     817.9815 (64)
Heat gains from water heating, kWh/month
              56.5647    49.5703    51.3855    45.1261    43.5424    37.9318    35.5045    40.2372    40.5683    46.8420    50.7060    54.8884 (65)
```

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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       160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              58.5738    52.0247    42.3093    32.0309    23.9435    20.2141    21.8420    28.3911    38.1065    48.3849    56.4723    60.2017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             367.5334   371.3472   361.7365   341.2763   315.4490   291.1749   274.9584   271.1445   280.7553   301.2155   327.0428   351.3169 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363 (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)
            -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644 (71)
Water heating gains (Table 5)
              76.0278    73.7653    69.0666    62.6751    58.5247    52.6831    47.7211    54.0822    56.3449    62.9597    70.4250    73.7747 (72)
Total internal gains
             612.4034   607.4057   583.3809   546.2508   508.1856   474.3406   454.7899   463.8863   485.4752   522.8285   564.2087   595.5618 (73)
```

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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
-------------------------------------------------------------------------------------------------------------------------------------
Northeast                                4.1200           14.6176           0.4600           0.0000           0.7700           21.3316 (75)
Southwest                                4.4900           45.1778           0.4600           0.0000           0.7700           71.8489 (79)
Northwest                                1.5400           14.6176           0.4600           0.0000           0.7700            7.9735 (81)
Southwest                                3.3300           45.1778           0.4600           0.0000           0.7700           53.2866 (79)
-------------------------------------------------------------------------------------------------------------------------------------

Solar gains    154.4406   232.4625   343.8604   468.0336   532.1462   589.8722   557.6542   497.1084   407.1536   283.8700   186.1997   128.7709 (83)
Total gains    766.8440   839.8682   927.2413  1014.2844  1040.3318  1064.2128  1012.4441   960.9947   892.6288   806.6985   750.4084   724.3327 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          35.6054    35.8390    35.7627    35.9137    35.9137    35.9868    36.0581    36.1278    36.1958    35.9868    36.1278    35.9868
alpha         3.3737     3.3893     3.3842     3.3942     3.3942     3.3991     3.4039     3.4085     3.4131     3.3991     3.4085     3.3991
util living area
               0.9614     0.9472     0.9107     0.8335     0.7087     0.5223     0.3906     0.4090     0.6421     0.8485     0.9367     0.9661 (86)

MIT           19.5425    19.7086    20.0492    20.4561    20.7686    20.9400    20.9831    20.9807    20.8766    20.5164    19.9959    19.5241 (87)
Th 2          19.9820    19.9880    19.9860    19.9899    19.9899    19.9917    19.9935    19.9952    19.9969    19.9917    19.9952    19.9917 (88)
util rest of house
               0.9540     0.9374     0.8939     0.8020     0.6537     0.4421     0.2945     0.3093     0.5649     0.8120     0.9228     0.9595 (89)
MIT 2         18.0732    18.3141    18.7954    19.3573    19.7588    19.9481    19.9858    19.9864    19.8947    19.4523    18.7343    18.0538 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.1809 (91)
MIT           18.3390    18.5663    19.0222    19.5560    19.9414    20.1275    20.1662    20.1662    20.0723    19.6448    18.9625    18.3197 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT  18.1890    18.4163    18.8722    19.4060    19.7914    19.9775    20.0162    20.0162    19.9223    19.4948    18.8125    18.1697 (93)
```

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9174	0.8708	0.7808	0.6418	0.4409	0.2967	0.3115	0.5586	0.7905	0.9015	0.9431	(94)
Useful gains	718.0611	770.4841	807.4481	791.9894	667.6395	469.1994	300.4369	299.3052	498.6262	637.6824	676.4666	683.1211	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1402.9204	1375.6620	1247.8327	1036.8045	763.1503	488.5718	303.9969	303.4105	542.3242	845.5110	1135.3756	1375.5934	(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													
	509.5353	406.6795	327.6461	176.2669	71.0600	0.0000	0.0000	0.0000	0.0000	154.6245	330.4144	515.1994	(98)
Space heating												2491.4262	(98)
Space heating per m2											(98) / (4) =	26.5045	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2752.9571	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	509.5353	406.6795	327.6461	176.2669	71.0600	0.0000	0.0000	0.0000	0.0000	154.6245	330.4144	515.1994	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	563.0224	449.3697	362.0399	194.7700	78.5194	0.0000	0.0000	0.0000	0.0000	170.8557	365.0988	569.2811	(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													
	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7736	89.7963	89.8127	89.8602	89.7504	87.3000	87.3000	87.3000	87.3000	89.3221	89.6182	89.7792	(217)
Fuel for water heating, kWh/month													
	160.7736	123.1604	96.2502	47.2864	23.3653	0.0000	0.0000	20.9557	48.3790	97.2740	135.2834	160.9436	(219)
Water heating fuel used												913.6715	(219)
Annual totals kWh/year													
Space heating fuel - main system												2752.9571	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2836.4238	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2752.9571	10.2300	281.6275	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	913.6715	10.2300	93.4686	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			173.2449	(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	2752.9571	0.2160	594.6387	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.6715	0.2160	197.3530	(264)
Space and water heating			791.9918	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			361.1155	(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	2752.9571	1.2200	3358.6077	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.6715	1.2200	1114.6793	(264)
Space and water heating			4473.2869	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1924.5582	(272)
Primary energy kWh/m2/year			20.4740	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	144.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	320.75 (P1)
Transmission heat loss coefficient	60.48 (37)
Summer heat loss coefficient	381.23 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.1200	106.0502	0.4600	0.0000	0.9000	180.8877
South West	4.4900	127.3119	0.4600	0.0000	0.9000	236.6549
North West	1.5400	106.0502	0.4600	0.0000	0.9000	67.6134
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						660.6707

	Jun	Jul	Aug	
Solar gains	710	661	587	(P4)
Internal gains	471	452	461	
Total summer gains	1182	1112	1048	(P5)
Summer gain/loss ratio	3.10	2.92	2.75	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 144.0)	0.99	0.99	0.99	
Threshold temperature	19.49	21.21	21.04	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-574.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	2-OP-SEMI
Property	32, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	92 A	**DER**	8.78	**TER**	18.39
Environmental	94 A	**% DER<TER**	52.26		
CO_2 Emissions (t/year)	0.42	**DFEE**	44.51	**TFEE**	52.27
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.85		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.39 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.78 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.47 (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
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South East: 2.47 m², No overhang
Windows facing South West: 8.01 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4700	
Infiltration rate		0.3680	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3404	(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	0.4340	0.4255	0.4170	0.3744	0.3659	0.3234	0.3234	0.3149	0.3404	0.3659	0.3829	0.4000	(22b)
Effective ac	0.5942	0.5905	0.5869	0.5701	0.5669	0.5523	0.5523	0.5496	0.5579	0.5669	0.5733	0.5800	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.7112	40.4606	40.2150	39.0614	38.8456	37.8409	37.8409	37.6548	38.2279	38.8456	39.2822	39.7387	(38)
Heat transfer coeff	97.9098	97.6592	97.4136	96.2600	96.0442	95.0394	95.0394	94.8534	95.4264	96.0442	96.4808	96.9373	(39)
Average = Sum(39)m / 12 =												96.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2190	1.2159	1.2128	1.1985	1.1958	1.1833	1.1833	1.1809	1.1881	1.1958	1.2012	1.2069	(40)
HLP (average)												1.1984	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
								Total per year (kWh/year) = Sum(64)m =				1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.8741	373.7566	360.1950	338.3391	316.1504	294.7828	280.9172	286.9257	298.1688	320.2367	345.5785	364.5813	(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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	2.4700	36.7938	0.4600	0.0000	0.7700	32.1900	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	151.0863	262.1745	371.5177	481.7818	559.2174	563.7868	539.9662	480.8789	409.4962	293.2096	181.8441	128.7306	(83)
Total gains	526.9604	635.9311	731.7128	820.1209	875.3678	858.5695	820.8834	767.8046	707.6650	613.4464	527.4226	493.3118	(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	33.6962	33.7826	33.8678	34.2737	34.3507	34.7139	34.7139	34.7820	34.5731	34.3507	34.1953	34.0342	
alpha	3.2464	3.2522	3.2579	3.2849	3.2900	3.3143	3.3143	3.3188	3.3049	3.2900	3.2797	3.2689	
util living area													
	0.9827	0.9680	0.9398	0.8798	0.7746	0.6233	0.4812	0.5271	0.7393	0.9115	0.9710	0.9859	(86)
MIT	19.1057	19.3764	19.7690	20.2444	20.6329	20.8749	20.9603	20.9458	20.7688	20.2498	19.5879	19.0571	(87)
Th 2	19.9048	19.9073	19.9098	19.9212	19.9234	19.9334	19.9334	19.9353	19.9295	19.9234	19.9190	19.9145	(88)
util rest of house													
	0.9791	0.9614	0.9273	0.8542	0.7260	0.5434	0.3757	0.4206	0.6684	0.8870	0.9640	0.9829	(89)
MIT 2	17.3919	17.7843	18.3481	19.0214	19.5379	19.8322	19.9123	19.9041	19.7211	19.0455	18.1018	17.3274	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.8212	18.1831	18.7041	19.3278	19.8122	20.0934	20.1748	20.1650	19.9835	19.3472	18.4740	17.7607	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6712	18.0331	18.5541	19.1778	19.6622	19.9434	20.0248	20.0150	19.8335	19.1972	18.3240	17.6107	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9682	0.9458	0.9068	0.8328	0.7127	0.5442	0.3851	0.4290	0.6612	0.8658	0.9492	0.9734	(94)
Useful gains	510.2005	601.4393	663.5528	682.9893	623.8710	467.2197	316.1624	329.4123	467.9326	531.1076	500.6296	480.2129	(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													
	1309.1695	1282.5704	1174.2305	989.3387	764.7260	507.8346	325.4914	342.8995	547.1307	825.7063	1082.9033	1299.9969	(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													
	594.4329	457.7201	379.9442	220.5716	104.7961	0.0000	0.0000	0.0000	0.0000	219.1814	419.2370	609.9193	(98)
Space heating												3005.8027	(98)
Space heating per m2											(98) / (4) =	37.4228	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3321.3290	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	594.4329	457.7201	379.9442	220.5716	104.7961	0.0000	0.0000	0.0000	0.0000	219.1814	419.2370	609.9193	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	656.8319	505.7681	419.8279	243.7255	115.7968	0.0000	0.0000	0.0000	0.0000	242.1894	463.2454	673.9440	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7812	89.7061	89.5651	89.2678	88.7068	87.3000	87.3000	87.3000	87.3000	89.2346	89.6375	89.8114	(217)
Fuel for water heating, kWh/month													
	185.0192	162.4009	168.9087	149.2619	145.2564	129.0595	121.2740	136.7748	137.7020	154.9784	166.4633	179.6204	(219)
Water heating fuel used												1836.7197	(219)
Annual totals kWh/year													
Space heating fuel - main system												3321.3290	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4369.8573	(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	3321.3290	0.2160	717.4071	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.7197	0.2160	396.7314	(264)
Space and water heating			1114.1385	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			705.0672	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.7800	(273)

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

DER		8.7800	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		27.2383	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.2383	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(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	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1100	1.3258	18.7064			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.1800	13.7628			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0408			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.8721	(36)
Total fabric heat loss (33) + (36) =	54.9129	(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	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.5870	96.2990	96.0168	94.6910	94.4430	93.2883	93.2883	93.0745	93.7331	94.4430	94.9448	95.4694	(39)
Average = Sum(39)m / 12 =												94.6899	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1989	1.1954	1.1789	1.1758	1.1615	1.1615	1.1588	1.1670	1.1758	1.1821	1.1886	(40)
HLP (average)												1.1789	(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	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(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													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	388.0676	385.6844	371.5020	349.0277	326.2155	304.2267	290.3700	296.9990	308.8697	331.5560	357.5134	376.7795	(73)

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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	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(77)
Southwest	8.0100	36.7938	0.6300	0.7000	0.7700	90.0698	(79)

Solar gains	130.3612	226.2110	320.5552	415.6939	482.5074	486.4499	465.8969	414.9149	353.3240	252.9889	156.8998	111.0721	(83)
Total gains	518.4288	611.8954	692.0572	764.7216	808.7229	790.6766	756.2669	711.9139	662.1937	584.5450	514.4132	487.8516	(84)

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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	57.7488	57.9214	58.0917	58.9050	59.0597	59.7907	59.7907	59.9281	59.5070	59.0597	58.7476	58.4248	
alpha	4.8499	4.8614	4.8728	4.9270	4.9373	4.9860	4.9860	4.9952	4.9671	4.9373	4.9165	4.8950	
util living area													
	0.9972	0.9934	0.9830	0.9501	0.8640	0.6991	0.5307	0.5816	0.8224	0.9673	0.9940	0.9979	(86)
MIT	19.7306	19.9076	20.1744	20.5124	20.7910	20.9483	20.9893	20.9835	20.8809	20.5149	20.0603	19.7030	(87)
Th 2	19.9180	19.9208	19.9237	19.9369	19.9394	19.9510	19.9510	19.9531	19.9465	19.9394	19.9344	19.9291	(88)
util rest of house													
	0.9963	0.9911	0.9770	0.9317	0.8152	0.6062	0.4104	0.4591	0.7452	0.9515	0.9916	0.9972	(89)
MIT 2	18.2352	18.4950	18.8829	19.3703	19.7367	19.9170	19.9471	19.9465	19.8534	19.3840	18.7281	18.2028	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.6098	18.8488	19.2064	19.6564	20.0008	20.1754	20.2082	20.2062	20.1108	19.6673	19.0618	18.5786	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6098	18.8488	19.2064	19.6564	20.0008	20.1754	20.2082	20.2062	20.1108	19.6673	19.0618	18.5786	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9946	0.9880	0.9717	0.9257	0.8184	0.6275	0.4407	0.4898	0.7589	0.9463	0.9888	0.9959	(94)
Useful gains	515.6330	604.5349	672.4507	707.9016	661.8422	496.1112	333.2755	348.7308	502.5128	553.1278	508.6282	485.8596	(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													
	1382.1428	1343.2586	1220.0310	1018.5325	783.9502	520.1183	336.6012	354.2640	563.4095	856.3433	1135.7135	1372.7128	(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													
	644.6833	496.4223	407.3997	223.6543	90.8483	0.0000	0.0000	0.0000	0.0000	225.5923	451.5015	659.8188	(98)
Space heating												3199.9205	(98)
Space heating per m2											(98) / (4) =	39.8396	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3426.0391	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	644.6833	496.4223	407.3997	223.6543	90.8483	0.0000	0.0000	0.0000	0.0000	225.5923	451.5015	659.8188	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	690.2391	531.5014	436.1881	239.4585	97.2680	0.0000	0.0000	0.0000	0.0000	241.5335	483.4063	706.4441	(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													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7625	87.4984	86.9842	85.8323	83.7031	80.3000	80.3000	80.3000	80.3000	85.7353	87.2285	87.8532	(217)
Fuel for water heating, kWh/month													
	230.6227	203.1414	212.6049	191.1004	189.7255	174.1812	166.8789	186.0308	188.0853	200.5950	210.4656	224.9453	(219)
Water heating fuel used												2378.3770	(219)
Annual totals kWh/year													
Space heating fuel - main system												3426.0391	(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)												355.3658	(232)
Total delivered energy for all uses												6234.7819	(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	3426.0391	0.2160	740.0244	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2378.3770	0.2160	513.7294	(264)
Space and water heating			1253.7539	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Total CO2, kg/m2/year			1477.1137	(272)
Emissions per m2 for space and water heating			15.6095	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2963	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6095 * 1.00) + 2.2963 + 0.4846, rounded to 2 d.p.			18.3900	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.4700	
Infiltration rate			0.3680	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3404	(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	0.4340	0.4255	0.4170	0.3744	0.3659	0.3234	0.3234	0.3149	0.3404	0.3659	0.3829	0.4000	(22b)
Effective ac	0.5942	0.5905	0.5869	0.5701	0.5669	0.5523	0.5523	0.5496	0.5579	0.5669	0.5733	0.5800	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.7112	40.4606	40.2150	39.0614	38.8456	37.8409	37.8409	37.6548	38.2279	38.8456	39.2822	39.7387	(38)
Heat transfer coeff	97.9098	97.6592	97.4136	96.2600	96.0442	95.0394	95.0394	94.8534	95.4264	96.0442	96.4808	96.9373	(39)
Average = Sum(39)m / 12 =												96.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2190	1.2159	1.2128	1.1985	1.1958	1.1833	1.1833	1.1809	1.1881	1.1958	1.2012	1.2069	(40)
HLP (average)												1.1984	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.5183	342.1819	330.2425	310.5891	289.8313	270.4758	258.3169	262.1348	272.5967	292.3856	315.1535	333.0010	(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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	2.4700	36.7938	0.4600	0.0000	0.7700	32.1900	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	151.0863	262.1745	371.5177	481.7818	559.2174	563.7868	539.9662	480.8789	409.4962	293.2096	181.8441	128.7306	(83)
Total gains	494.6046	604.3564	701.7603	792.3709	849.0487	834.2626	798.2831	743.0137	682.0929	585.5953	496.9975	461.7315	(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	33.6962	33.7826	33.8678	34.2737	34.3507	34.7139	34.7139	34.7820	34.5731	34.3507	34.1953	34.0342	
alpha	3.2464	3.2522	3.2579	3.2849	3.2900	3.3143	3.3143	3.3188	3.3049	3.2900	3.2797	3.2689	
util living area													
	0.9855	0.9721	0.9457	0.8884	0.7860	0.6359	0.4927	0.5412	0.7540	0.9206	0.9754	0.9883	(86)
MIT	19.0541	19.3288	19.7283	20.2144	20.6146	20.8670	20.9574	20.9414	20.7536	20.2156	19.5412	19.0061	(87)
Th 2	19.9048	19.9073	19.9098	19.9212	19.9234	19.9334	19.9334	19.9353	19.9295	19.9234	19.9190	19.9145	(88)
util rest of house													
	0.9825	0.9663	0.9342	0.8640	0.7384	0.5558	0.3855	0.4331	0.6843	0.8979	0.9693	0.9858	(89)
MIT 2	18.1382	18.4113	18.8047	19.2798	19.6456	19.8595	19.9178	19.9120	19.7765	19.2928	18.6328	18.0976	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3677	18.6411	19.0360	19.5139	19.8883	20.1119	20.1782	20.1699	20.0213	19.5240	18.8603	18.3252	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3677	18.6411	19.0360	19.5139	19.8883	20.1119	20.1782	20.1699	20.0213	19.5240	18.8603	18.3252	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9766	0.9575	0.9227	0.8532	0.7367	0.5702	0.4112	0.4582	0.6910	0.8876	0.9614	0.9808	(94)
Useful gains	483.0507	578.6793	647.5293	676.0700	625.5125	475.6873	328.2343	340.4841	471.3234	519.7798	477.8035	452.8861	(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													
	1377.3607	1341.9442	1221.1793	1021.6929	786.4418	523.8456	340.0743	357.5877	565.0447	857.0943	1134.6477	1369.2594	(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													
	665.3667	512.9140	426.7956	248.8485	119.7313	0.0000	0.0000	0.0000	0.0000	250.9620	472.9278	681.7817	(98)
Space heating												3379.3276	(98)
Space heating per m2											(98) / (4) =	42.0733	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	893.3705	703.2917	720.8855	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8314	0.8875	0.8645	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	742.7066	624.1546	623.2090	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1067.3786	1023.4329	960.4375	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	233.7639	297.0631	250.8980	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												781.7249	(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	58.4410	74.2658	62.7245	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												195.4312	(107)
Space cooling per m2												2.4332	(108)
Energy for space heating												42.0733	(99)
Energy for space cooling												2.4332	(108)
Total												44.5065	(109)
Dwelling Fabric Energy Efficiency (DFEE)												44.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(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	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1100	1.3258	18.7064			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.1800	13.7628			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0408			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.8721	(36)
Total fabric heat loss (33) + (36) =	54.9129	(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	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.5870	96.2990	96.0168	94.6910	94.4430	93.2883	93.2883	93.0745	93.7331	94.4430	94.9448	95.4694	(39)
Average = Sum(39)m / 12 =												94.6899	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1989	1.1954	1.1789	1.1758	1.1615	1.1615	1.1588	1.1670	1.1758	1.1821	1.1886	(40)
HLP (average)												1.1789	(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	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.5183	342.1819	330.2425	310.5891	289.8313	270.4758	258.3169	262.1348	272.5967	292.3856	315.1535	333.0010	(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	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southeast	2.4700	36.7938	0.6300	0.7000	0.7700	27.7743	(77)
Southwest	8.0100	36.7938	0.6300	0.7000	0.7700	90.0698	(79)

Solar gains	130.3612	226.2110	320.5552	415.6939	482.5074	486.4499	465.8969	414.9149	353.3240	252.9889	156.8998	111.0721	(83)
Total gains	473.8795	568.3929	650.7977	726.2830	772.3387	756.9258	724.2138	677.0496	625.9207	545.3746	472.0533	444.0730	(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	57.7488	57.9214	58.0917	58.9050	59.0597	59.7907	59.7907	59.9281	59.5070	59.0597	58.7476	58.4248	
alpha	4.8499	4.8614	4.8728	4.9270	4.9373	4.9860	4.9860	4.9952	4.9671	4.9373	4.9165	4.8950	
util living area													
	0.9981	0.9952	0.9868	0.9585	0.8802	0.7215	0.5518	0.6072	0.8457	0.9749	0.9959	0.9987	(86)
MIT	19.6797	19.8587	20.1302	20.4770	20.7690	20.9406	20.9873	20.9801	20.8632	20.4757	20.0123	19.6526	(87)
Th 2	19.9180	19.9208	19.9237	19.9369	19.9394	19.9510	19.9510	19.9531	19.9465	19.9394	19.9344	19.9291	(88)
util rest of house													
	0.9975	0.9935	0.9819	0.9426	0.8347	0.6288	0.4279	0.4814	0.7727	0.9623	0.9942	0.9982	(89)
MIT 2	18.7183	18.8989	19.1700	19.5176	19.7840	19.9238	19.9478	19.9475	19.8715	19.5236	19.0634	18.7002	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9591	19.1393	19.4106	19.7579	20.0308	20.1785	20.2082	20.2062	20.1199	19.7621	19.3011	18.9388	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9591	19.1393	19.4106	19.7579	20.0308	20.1785	20.2082	20.2062	20.1199	19.7621	19.3011	18.9388	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9919	0.9790	0.9393	0.8392	0.6504	0.4593	0.5132	0.7865	0.9595	0.9928	0.9976	(94)
Useful gains	472.3165	563.7654	637.1046	682.1928	648.1330	492.3151	332.6127	347.4740	492.2932	523.3069	468.6493	442.9978	(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													
	1415.8817	1371.2335	1239.6298	1028.1464	786.7813	520.4104	336.6028	354.2582	564.2625	865.2976	1158.4300	1407.1044	(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													
	702.0126	542.6186	448.2787	249.0866	103.1543	0.0000	0.0000	0.0000	0.0000	254.4411	496.6422	717.2953	(98)
Space heating												3513.5293	(98)
Space heating per m2											(98) / (4) =	43.7441	(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	876.9103	690.3336	707.3662	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8745	0.9316	0.9108	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	766.8893	643.1130	644.2529	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	976.9849	936.8584	883.3367	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	151.2689	218.5466	177.8783	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												547.6938	(104)

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	37.8172	54.6366	44.4696	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												136.9234 (107)
Space cooling per m2												1.7047 (108)
Energy for space heating												43.7441 (99)
Energy for space cooling												1.7047 (108)
Total												45.4489 (109)
Target Fabric Energy Efficiency (TFEE)												52.3 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4700	
Infiltration rate		0.3680	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3404	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3574	0.3319	0.3404	0.3234	0.3234	0.3149	0.3064	0.2978	0.2893	0.3149	0.2978	0.3149	(22b)
Effective ac	0.5639	0.5551	0.5579	0.5523	0.5523	0.5496	0.5469	0.5444	0.5419	0.5496	0.5444	0.5496	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	38.6347	38.0319	38.2279	37.8409	37.8409	37.6548	37.4737	37.2975	37.1264	37.6548	37.2975	37.6548	(38)
Heat transfer coeff	95.8333	95.2304	95.4264	95.0394	95.0394	94.8534	94.6723	94.4961	94.3249	94.8534	94.4961	94.8534	(39)
Average = Sum(39)m / 12 =												94.9265	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1931	1.1856	1.1881	1.1833	1.1833	1.1809	1.1787	1.1765	1.1744	1.1809	1.1765	1.1809	(40)
HLP (average)												1.1819	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (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

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
RHI water heating demand 1632 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (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)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)
Total internal gains	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585 (73)

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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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	2.4700	45.1778	0.4600	0.0000	0.7700	39.5249	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	186.4954	275.8156	395.6681	519.8287	576.6766	632.9685	600.9008	545.9633	461.8079	333.2196	223.7952	156.1718 (83)
Total gains	742.5912	827.5441	925.9938	1016.9668	1039.8401	1065.6825	1015.8048	969.1255	904.0545	808.8658	736.5691	697.0303 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4263	34.6442	34.5731	34.7139	34.7139	34.7820	34.8485	34.9135	34.9768	34.7820	34.9135	34.7820	
alpha	3.2951	3.3096	3.3049	3.3143	3.3143	3.3188	3.3232	3.3276	3.3318	3.3188	3.3276	3.3188	
util living area	0.9513	0.9316	0.8849	0.7951	0.6637	0.4796	0.3554	0.3707	0.5909	0.8117	0.9195	0.9577	(86)
MIT	19.5719	19.7612	20.1169	20.5132	20.7986	20.9493	20.9859	20.9841	20.8969	20.5649	20.0387	19.5439	(87)
Th 2	19.9255	19.9315	19.9295	19.9334	19.9334	19.9353	19.9371	19.9388	19.9406	19.9353	19.9388	19.9353	(88)
util rest of house	0.9420	0.9190	0.8638	0.7584	0.6048	0.3995	0.2621	0.2740	0.5110	0.7688	0.9021	0.9494	(89)
MIT 2	18.0741	18.3460	18.8430	19.3811	19.7390	19.9002	19.9311	19.9320	19.8593	19.4643	18.7505	18.0415	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4493	18.7005	19.1621	19.6647	20.0045	20.1630	20.1953	20.1956	20.1192	19.7400	19.0732	18.4179	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2993	18.5505	19.0121	19.5147	19.8545	20.0130	20.0453	20.0456	19.9692	19.5900	18.9232	18.2679	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8983	0.8420	0.7422	0.6001	0.4055	0.2718	0.2840	0.5133	0.7527	0.8810	0.9319	(94)
Useful gains	685.6473	743.3795	779.7219	754.7435	624.0389	432.1718	276.0748	275.2069	464.0612	608.8350	648.9159	649.5670	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1284.1004	1261.8524	1146.2690	951.7909	698.9635	447.0437	278.8403	278.3448	497.0186	776.8507	1041.6452	1258.5014	(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	445.2491	348.4138	272.7110	141.8741	55.7439	0.0000	0.0000	0.0000	0.0000	125.0037	282.7651	453.0472	(98)

Space heating 2124.8079 (98)
RHI space heating demand 2125 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4700	
Infiltration rate		0.3680	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3404	(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	0.4340	0.4255	0.4170	0.3744	0.3659	0.3234	0.3234	0.3149	0.3404	0.3659	0.3829	0.4000	(22b)
Effective ac	0.5942	0.5905	0.5869	0.5701	0.5669	0.5523	0.5523	0.5496	0.5579	0.5669	0.5733	0.5800	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.7112	40.4606	40.2150	39.0614	38.8456	37.8409	37.8409	37.6548	38.2279	38.8456	39.2822	39.7387	(38)
Heat transfer coeff	97.9098	97.6592	97.4136	96.2600	96.0442	95.0394	95.0394	94.8534	95.4264	96.0442	96.4808	96.9373	(39)
Average = Sum(39)m / 12 =												96.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2190	1.2159	1.2128	1.1985	1.1958	1.1833	1.1833	1.1809	1.1881	1.1958	1.2012	1.2069	(40)
HLP (average)												1.1984	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)

Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (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

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (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)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585 (73)

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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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southeast	2.4700	36.7938	0.4600	0.0000	0.7700	32.1900	(77)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	151.0863	262.1745	371.5177	481.7818	559.2174	563.7868	539.9662	480.8789	409.4962	293.2096	181.8441	128.7306 (83)
Total gains	707.1821	813.9030	901.8434	978.9199	1022.3809	996.5008	954.8701	904.0411	851.7428	768.8559	694.6179	669.5890 (84)

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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	33.6962	33.7826	33.8678	34.2737	34.3507	34.7139	34.7139	34.7820	34.5731	34.3507	34.1953	34.0342	
alpha	3.2464	3.2522	3.2579	3.2849	3.2900	3.3143	3.3143	3.3188	3.3049	3.2900	3.2797	3.2689	
util living area	0.9616	0.9397	0.9016	0.8284	0.7127	0.5578	0.4215	0.4594	0.6612	0.8557	0.9407	0.9670	(86)
MIT	19.3806	19.6297	19.9821	20.3968	20.7193	20.9104	20.9732	20.9640	20.8371	20.4184	19.8286	19.3313	(87)
Th 2	19.9048	19.9073	19.9098	19.9212	19.9234	19.9334	19.9334	19.9353	19.9295	19.9234	19.9190	19.9145	(88)
util rest of house	0.9542	0.9285	0.8833	0.7965	0.6602	0.4805	0.3260	0.3621	0.5871	0.8216	0.9278	0.9607	(89)
MIT 2	17.7864	18.1429	18.6420	19.2190	19.6366	19.8632	19.9196	19.9153	19.7889	19.2644	18.4411	17.7220	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.1857	18.5153	18.9777	19.5140	19.9078	20.1255	20.1835	20.1780	20.0514	19.5534	18.7887	18.1251	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0357	18.3653	18.8277	19.3640	19.7578	19.9755	20.0335	20.0280	19.9014	19.4034	18.6387	17.9751	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9370	0.9080	0.8610	0.7774	0.6514	0.4838	0.3353	0.3709	0.5850	0.8019	0.9077	0.9449	(94)
Useful gains	662.6637	739.0080	776.4550	761.0556	665.9638	482.0748	320.1411	335.3529	498.2923	616.5775	630.4908	632.6919	(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	1344.8616	1315.0150	1200.8813	1007.2682	773.9031	510.8828	326.3190	344.1285	553.6107	845.5186	1113.2625	1335.3206	(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	507.5553	387.0767	315.7732	177.2731	80.3069	0.0000	0.0000	0.0000	0.0000	170.3321	347.5957	522.7557	(98)
Space heating												2508.6687	(98)
Space heating per m2											(98) / (4) =	31.2334	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2772.0096	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	507.5553	387.0767	315.7732	177.2731	80.3069	0.0000	0.0000	0.0000	0.0000	170.3321	347.5957	522.7557	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	560.8346	427.7090	348.9207	195.8819	88.7369	0.0000	0.0000	0.0000	0.0000	188.2123	384.0836	577.6307	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6894	89.6019	89.4381	89.0986	88.5015	87.3000	87.3000	87.3000	87.3000	89.0376	89.5145	89.7244	(217)
Fuel for water heating, kWh/month													
	185.2087	162.5898	169.1485	149.5453	145.5934	129.0595	121.2740	136.7748	137.7020	155.3214	166.6921	179.7946	(219)
Water heating fuel used												1838.7041	(219)
Annual totals kWh/year													
Space heating fuel - main system												2772.0096	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3822.5224	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2772.0096	3.4800	96.4659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.7041	3.4800	63.9869	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	355.3658	13.1900	46.8727	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			176.4904	(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] =	0.5915	(257)
SAP value		91.7487	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	2772.0096	0.2160	598.7541	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.7041	0.2160	397.1601	(264)
Space and water heating			995.9142	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			586.8429	(272)
CO2 emissions per m2			7.3100	(273)
EI value			93.7251	
EI rating			94	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8865 = 3.926, stars = 4
Water heating environmental impact	0.216 / 0.8865 = 0.2437, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.4700	
Infiltration rate				0.3680	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3404	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3574	0.3319	0.3404	0.3234	0.3234	0.3149	0.3064	0.2978	0.2893	0.3149	0.2978	0.3149	(22b)
Effective ac	0.5639	0.5551	0.5579	0.5523	0.5523	0.5496	0.5469	0.5444	0.5419	0.5496	0.5444	0.5496	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	38.6347	38.0319	38.2279	37.8409	37.8409	37.6548	37.4737	37.2975	37.1264	37.6548	37.2975	37.6548	(38)
Heat transfer coeff	95.8333	95.2304	95.4264	95.0394	95.0394	94.8534	94.6723	94.4961	94.3249	94.8534	94.4961	94.8534	(39)
Average = Sum(39)m / 12 =												94.9265	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1931	1.1856	1.1881	1.1833	1.1833	1.1809	1.1787	1.1765	1.1744	1.1809	1.1765	1.1809	(40)
HLP (average)												1.1819	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585	(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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	2.4700	45.1778	0.4600	0.0000	0.7700	39.5249	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	186.4954	275.8156	395.6681	519.8287	576.6766	632.9685	600.9008	545.9633	461.8079	333.2196	223.7952	156.1718	(83)
Total gains	742.5912	827.5441	925.9938	1016.9668	1039.8401	1065.6825	1015.8048	969.1255	904.0545	808.8658	736.5691	697.0303	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4263	34.6442	34.5731	34.7139	34.7139	34.7820	34.8485	34.9135	34.9768	34.7820	34.9135	34.7820	
alpha	3.2951	3.3096	3.3049	3.3143	3.3143	3.3188	3.3232	3.3276	3.3318	3.3188	3.3276	3.3188	
util living area													
	0.9513	0.9316	0.8849	0.7951	0.6637	0.4796	0.3554	0.3707	0.5909	0.8117	0.9195	0.9577	(86)
MIT	19.5719	19.7612	20.1169	20.5132	20.7986	20.9493	20.9859	20.9841	20.8969	20.5649	20.0387	19.5439	(87)
Th 2	19.9255	19.9315	19.9295	19.9334	19.9334	19.9353	19.9371	19.9388	19.9406	19.9353	19.9388	19.9353	(88)
util rest of house													
	0.9420	0.9190	0.8638	0.7584	0.6048	0.3995	0.2621	0.2740	0.5110	0.7688	0.9021	0.9494	(89)
MIT 2	18.0741	18.3460	18.8430	19.3811	19.7390	19.9002	19.9311	19.9320	19.8593	19.4643	18.7505	18.0415	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4493	18.7005	19.1621	19.6647	20.0045	20.1630	20.1953	20.1956	20.1192	19.7400	19.0732	18.4179	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2993	18.5505	19.0121	19.5147	19.8545	20.0130	20.0453	20.0456	19.9692	19.5900	18.9232	18.2679	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8983	0.8420	0.7422	0.6001	0.4055	0.2718	0.2840	0.5133	0.7527	0.8810	0.9319	(94)
Useful gains	685.6473	743.3795	779.7219	754.7435	624.0389	432.1718	276.0748	275.2069	464.0612	608.8350	648.9159	649.5670	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1284.1004	1261.8524	1146.2690	951.7909	698.9635	447.0437	278.8403	278.3448	497.0186	776.8507	1041.6452	1258.5014	(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													
	445.2491	348.4138	272.7110	141.8741	55.7439	0.0000	0.0000	0.0000	0.0000	125.0037	282.7651	453.0472	(98)
Space heating												2124.8079	(98)
Space heating per m2											(98) / (4) =	26.4543	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2347.8541	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	445.2491	348.4138	272.7110	141.8741	55.7439	0.0000	0.0000	0.0000	0.0000	125.0037	282.7651	453.0472	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	491.9880	384.9877	301.3382	156.7669	61.5954	0.0000	0.0000	0.0000	0.0000	138.1256	312.4476	500.6047	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6075	89.5324	89.3317	88.9214	88.2422	87.3000	87.3000	87.3000	87.3000	88.7905	89.3685	89.6373	(217)
Fuel for water heating, kWh/month													
	185.3777	162.7161	169.3501	149.8433	146.0212	129.0595	121.2740	136.7748	137.7020	155.7535	166.9645	179.9694	(219)
Water heating fuel used												1840.8061	(219)
Annual totals kWh/year													
Space heating fuel - main system												2347.8541	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3250.0488	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2347.8541	10.2300	240.1855	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.8061	10.2300	188.3145	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	355.3658	36.7200	130.4903	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			186.8418	(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	2347.8541	0.2160	507.1365	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.8061	0.2160	397.6141	(264)
Space and water heating			904.7506	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			417.6113	(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	2347.8541	1.2200	2864.3820	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.8061	1.2200	2245.7835	(264)
Space and water heating			5110.1654	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	355.3658	3.0700	1090.9729	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2228.6286	(272)
Primary energy kWh/m2/year			27.7469	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 82	-186 kg (44.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£82	2.31 kg/m²	A 93	A 96
Total Savings	£82	2.31 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£158	£176	-£18
Mains gas	£531	£431	£100
Space heating	£371	£371	£0
Water heating	£188	£107	£82
Lighting	£130	£130	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£186	£104	£82
Total cost of uses	£186	£105	£82
Delivered energy	40 kWh/m²	29 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	28 kWh/m²	15 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.4700	
Infiltration rate			0.3680	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3404	(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	0.4340	0.4255	0.4170	0.3744	0.3659	0.3234	0.3234	0.3149	0.3404	0.3659	0.3829	0.4000	(22b)
Effective ac	0.5942	0.5905	0.5869	0.5701	0.5669	0.5523	0.5523	0.5496	0.5579	0.5669	0.5733	0.5800	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.7112	40.4606	40.2150	39.0614	38.8456	37.8409	37.8409	37.6548	38.2279	38.8456	39.2822	39.7387	(38)
Heat transfer coeff	97.9098	97.6592	97.4136	96.2600	96.0442	95.0394	95.0394	94.8534	95.4264	96.0442	96.4808	96.9373	(39)
Average = Sum(39)m / 12 =												96.2590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2190	1.2159	1.2128	1.1985	1.1958	1.1833	1.1833	1.1809	1.1881	1.1958	1.2012	1.2069	(40)
HLP (average)												1.1984	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                          Total = Sum(45)m =   1460.6794 (45)
Distribution loss  (46)m = 0.15 x (45)m
              22.7162    19.8677    20.5017    17.8739    17.1504    14.7995    13.7139    15.7369    15.9249    18.5589    20.2585    21.9994 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.6712    13.2321    14.6052    14.0835    14.5162    14.0056    14.4461    14.4916    14.0481    14.5684    14.1570    14.6569 (61)
Total heat required for water heating calculated for each month
             166.1124   145.6836   151.2832   133.2428   128.8524   112.6690   105.8722   119.4044   120.2139   138.2944   149.2136   161.3196 (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                                                                                                                 1.2416 (H8)
Utilisation factor                                                                                                                  0.5531 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             92.8365 (H14)
Volume ratio Veff/V                                                                                                                 0.8079 (H15)
Solar storage volume factor                                                                                                         0.9573 (H16)
Solar input                                                                                                                      -844.3736 (H17)
Solar input    -24.4852   -40.8587   -69.5870   -93.2603  -115.2152  -113.2749  -111.7780   -97.6610   -76.4881   -52.2324   -29.0429   -20.4899 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -844.3736 (63)
Output from w/h
             141.6273   104.8249    81.6962    39.9825    13.6371     0.0000     0.0000    21.7434    43.7257    86.0620   120.1707   140.8297 (64)
                                                                                Total per year (kWh/year) = Sum(64)m =      794.2995 (64)
Heat gains from water heating, kWh/month
              54.0220    47.3481    49.0967    43.1413    41.6458    36.3070    34.0107    38.5064    38.8121    44.7810    48.4456    52.4296 (65)
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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      148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343   148.1343 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              50.3057    44.6811    36.3371    27.5095    20.5637    17.3607    18.7589    24.3835    32.7275    41.5551    48.5009    51.7039 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             328.5195   331.9285   323.3379   305.0496   281.9638   260.2665   245.7713   242.3623   250.9529   269.2413   292.3270   314.0243 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823    52.2823 (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)
             -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562   -98.7562 (71)
Water heating gains (Table 5)
              72.6102    70.4585    65.9902    59.9185    55.9756    50.4264    45.7133    51.7559    53.9058    60.1895    67.2855    70.4699 (72)
Total internal gains
             556.0958   551.7285   530.3257   497.1380   463.1635   432.7140   414.9040   423.1622   442.2466   475.6463   512.7738   540.8585 (73)
```

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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
-----------------------------------------------------------------------------------------------------------------------------------
Northeast                                3.6300          11.2829           0.4600           0.0000           0.7700           14.5070 (75)
Southeast                                2.4700          36.7938           0.4600           0.0000           0.7700           32.1900 (77)
Southwest                                4.6800          36.7938           0.4600           0.0000           0.7700           60.9915 (79)
Southwest                                3.3300          36.7938           0.4600           0.0000           0.7700           43.3978 (79)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    151.0863   262.1745   371.5177   481.7818   559.2174   563.7868   539.9662   480.8789   409.4962   293.2096   181.8441   128.7306 (83)
Total gains    707.1821   813.9030   901.8434   978.9199  1022.3809   996.5008   954.8701   904.0411   851.7428   768.8559   694.6179   669.5890 (84)
```

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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            33.6962    33.7826    33.8678    34.2737    34.3507    34.7139    34.7139    34.7820    34.5731    34.3507    34.1953    34.0342
alpha           3.2464     3.2522     3.2579     3.2849     3.2900     3.3143     3.3143     3.3188     3.3049     3.2900     3.2797     3.2689
util living area
               0.9616     0.9397     0.9016     0.8284     0.7127     0.5578     0.4215     0.4594     0.6612     0.8557     0.9407     0.9670 (86)

MIT            19.3806    19.6297    19.9821    20.3968    20.7193    20.9104    20.9732    20.9640    20.8371    20.4184    19.8286    19.3313 (87)
Th 2           19.9048    19.9073    19.9098    19.9212    19.9234    19.9334    19.9334    19.9353    19.9295    19.9234    19.9190    19.9145 (88)
util rest of house
               0.9542     0.9285     0.8833     0.7965     0.6602     0.4805     0.3260     0.3621     0.5871     0.8216     0.9278     0.9607 (89)
MIT 2          17.7864    18.1429    18.6420    19.2190    19.6366    19.8632    19.9196    19.9153    19.7889    19.2644    18.4411    17.7220 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.2505 (91)
MIT            18.1857    18.5153    18.9777    19.5140    19.9078    20.1255    20.1835    20.1780    20.0514    19.5534    18.7887    18.1251 (92)
Temperature adjustment                                                                                                            -0.1500
adjusted MIT   18.0357    18.3653    18.8277    19.3640    19.7578    19.9755    20.0335    20.0280    19.9014    19.4034    18.6387    17.9751 (93)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9370	0.9080	0.8610	0.7774	0.6514	0.4838	0.3353	0.3709	0.5850	0.8019	0.9077	0.9449	(94)
Useful gains	662.6637	739.0080	776.4550	761.0556	665.9638	482.0748	320.1411	335.3529	498.2923	616.5775	630.4908	632.6919	(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	1344.8616	1315.0150	1200.8813	1007.2682	773.9031	510.8828	326.3190	344.1285	553.6107	845.5186	1113.2625	1335.3206	(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	507.5553	387.0767	315.7732	177.2731	80.3069	0.0000	0.0000	0.0000	0.0000	170.3321	347.5957	522.7557	(98)
Space heating												2508.6687	(98)
Space heating per m2											(98) / (4) =	31.2334	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2772.0096	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	507.5553	387.0767	315.7732	177.2731	80.3069	0.0000	0.0000	0.0000	0.0000	170.3321	347.5957	522.7557	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	560.8346	427.7090	348.9207	195.8819	88.7369	0.0000	0.0000	0.0000	0.0000	188.2123	384.0836	577.6307	(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	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7820	89.7986	89.8233	89.8936	90.0210	87.3000	87.3000	87.3000	87.3000	89.4000	89.6557	89.8014	(217)
Fuel for water heating, kWh/month	157.7457	116.7334	90.9522	44.4775	15.1488	0.0000	0.0000	24.9065	50.0868	96.2662	134.0357	156.8235	(219)
Water heating fuel used												887.1763	(219)

Annual totals kWh/year		
Space heating fuel - main system	2772.0096	(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)	355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571	-1218.5571	(233)
Total delivered energy for all uses	2920.9946	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2772.0096	3.4800	96.4659	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	887.1763	3.4800	30.8737	(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	355.3658	13.1900	46.8727	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			149.9722	(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] =	0.5026	(257)
SAP value	92.9885	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2772.0096	0.2160	598.7541	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	887.1763	0.2160	191.6301	(264)
Space and water heating			790.3842	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			407.2629	(272)
CO2 emissions per m2			5.0700	(273)
EI value			95.6453	
EI rating			96	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.4700	
Infiltration rate		0.3680	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3404	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3574	0.3319	0.3404	0.3234	0.3234	0.3149	0.3064	0.2978	0.2893	0.3149	0.2978	0.3149	(22b)
Effective ac	0.5639	0.5551	0.5579	0.5523	0.5523	0.5496	0.5469	0.5444	0.5419	0.5496	0.5444	0.5496	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	38.6347	38.0319	38.2279	37.8409	37.8409	37.6548	37.4737	37.2975	37.1264	37.6548	37.2975	37.6548	(38)
Heat transfer coeff	95.8333	95.2304	95.4264	95.0394	95.0394	94.8534	94.6723	94.4961	94.3249	94.8534	94.4961	94.8534	(39)
Average = Sum(39)m / 12 =												94.9265	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1931	1.1856	1.1881	1.1833	1.1833	1.1809	1.1787	1.1765	1.1744	1.1809	1.1765	1.1809	(40)
HLP (average)												1.1819	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1208.1510 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	2029.6937 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3896 (H8)
Utilisation factor	0.5131 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	92.8365 (H14)
Volume ratio Veff/V	0.8079 (H15)
Solar storage volume factor	0.9573 (H16)
Solar input	-876.6189 (H17)

Solar input

	-28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154 (63)

Solar input (sum of months) = Sum(63)m = -876.6189 (63)

Output from w/h

	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042 (64)

Total per year (kWh/year) = Sum(64)m = 771.1322 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (65)

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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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (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)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585 (73)

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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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southeast	2.4700	45.1778	0.4600	0.0000	0.7700	39.5249	(77)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	186.4954	275.8156	395.6681	519.8287	576.6766	632.9685	600.9008	545.9633	461.8079	333.2196	223.7952	156.1718 (83)
Total gains	742.5912	827.5441	925.9938	1016.9668	1039.8401	1065.6825	1015.8048	969.1255	904.0545	808.8658	736.5691	697.0303 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4263	34.6442	34.5731	34.7139	34.7139	34.7820	34.8485	34.9135	34.9768	34.7820	34.9135	34.7820	
alpha	3.2951	3.3096	3.3049	3.3143	3.3143	3.3188	3.3232	3.3276	3.3318	3.3188	3.3276	3.3188	

util living area

	0.9513	0.9316	0.8849	0.7951	0.6637	0.4796	0.3554	0.3707	0.5909	0.8117	0.9195	0.9577 (86)

MIT	19.5719	19.7612	20.1169	20.5132	20.7986	20.9493	20.9859	20.9841	20.8969	20.5649	20.0387	19.5439 (87)
Th 2	19.9255	19.9315	19.9295	19.9334	19.9334	19.9353	19.9371	19.9388	19.9406	19.9353	19.9388	19.9353 (88)

util rest of house

	0.9420	0.9190	0.8638	0.7584	0.6048	0.3995	0.2621	0.2740	0.5110	0.7688	0.9021	0.9494 (89)
MIT 2	18.0741	18.3460	18.8430	19.3811	19.7390	19.9002	19.9311	19.9320	19.8593	19.4643	18.7505	18.0415 (90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.4493	18.7005	19.1621	19.6647	20.0045	20.1630	20.1953	20.1956	20.1192	19.7400	19.0732	18.4179 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.2993	18.5505	19.0121	19.5147	19.8545	20.0130	20.0453	20.0456	19.9692	19.5900	18.9232	18.2679 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8983	0.8420	0.7422	0.6001	0.4055	0.2718	0.2840	0.5133	0.7527	0.8810	0.9319	(94)
Useful gains	685.6473	743.3795	779.7219	754.7435	624.0389	432.1718	276.0748	275.2069	464.0612	608.8350	648.9159	649.5670	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1284.1004	1261.8524	1146.2690	951.7909	698.9635	447.0437	278.8403	278.3448	497.0186	776.8507	1041.6452	1258.5014	(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													
	445.2491	348.4138	272.7110	141.8741	55.7439	0.0000	0.0000	0.0000	0.0000	125.0037	282.7651	453.0472	(98)
Space heating												2124.8079	(98)
Space heating per m2											(98) / (4) =	26.4543	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2347.8541	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	445.2491	348.4138	272.7110	141.8741	55.7439	0.0000	0.0000	0.0000	0.0000	125.0037	282.7651	453.0472	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	491.9880	384.9877	301.3382	156.7669	61.5954	0.0000	0.0000	0.0000	0.0000	138.1256	312.4476	500.6047	(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													
	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7239	89.7381	89.7439	89.7911	89.6944	87.3000	87.3000	87.3000	87.3000	89.2030	89.5487	89.7329	(217)
Fuel for water heating, kWh/month													
	153.2646	117.0292	90.6937	43.3711	20.1708	0.0000	0.0000	18.0306	44.7335	92.1293	128.8577	153.5716	(219)
Water heating fuel used												861.8521	(219)
Annual totals kWh/year													
Space heating fuel - main system												2347.8541	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2321.0948	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2347.8541	10.2300	240.1855	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.8521	10.2300	88.1675	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	355.3658	36.7200	130.4903	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			105.0549	(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	2347.8541	0.2160	507.1365	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.8521	0.2160	186.1601	(264)
Space and water heating			693.2965	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			232.1072 (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	2347.8541	1.2200	2864.3820	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.8521	1.2200	1051.4596	(264)
Space and water heating			3915.8415	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	355.3658	3.0700	1090.9729	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1187.8047	(272)
Primary energy kWh/m2/year			14.7884	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07 (P1)
Transmission heat loss coefficient	57.20 (37)
Summer heat loss coefficient	331.27 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	106.0502	0.4600	0.0000	0.9000	159.3744
South East	2.4700	127.3119	0.4600	0.0000	0.9000	130.1866
South West	4.6800	127.3119	0.4600	0.0000	0.9000	246.6693
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						711.7449

	Jun	Jul	Aug	
Solar gains	762	712	644	(P4)
Internal gains	430	412	420	
Total summer gains	1192	1124	1065	(P5)
Summer gain/loss ratio	3.60	3.39	3.21	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 147.9)	0.96	0.96	0.96	
Threshold temperature	19.96	21.66	21.48	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-575.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	2-As-SEMI
Property	34, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	92 A	**DER**	9.00	**TER**	18.69
Environmental	94 A	**% DER<TER**	51.83		
CO_2 Emissions (t/year)	0.43	**DFEE**	45.42	**TFEE**	53.74
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.48		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.69 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.00 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.20 (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
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 3.63 m², No overhang
Windows facing South West: 8.01 m², No overhang
Windows facing North West: 2.47 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.038 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.2000	
Infiltration rate		0.3545	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.2465	40.0139	39.7860	38.7155	38.5152	37.5828	37.5828	37.4102	37.9420	38.5152	38.9204	39.3440	(38)
Heat transfer coeff	97.4450	97.2125	96.9846	95.9141	95.7138	94.7814	94.7814	94.6087	95.1405	95.7138	96.1190	96.5426	(39)
Average = Sum(39)m / 12 =												95.9131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2132	1.2103	1.2075	1.1941	1.1917	1.1800	1.1800	1.1779	1.1845	1.1917	1.1967	1.2020	(40)
HLP (average)												1.1941	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
									Total per year (kWh/year) = Sum(64)m =			1632.1614	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	375.8741	373.7566	360.1950	338.3391	316.1504	294.7828	280.9172	286.9257	298.1688	320.2367	345.5785	364.5813	(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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	128.7675	227.4361	332.6962	448.2778	535.0143	545.6195	520.0119	453.0898	372.3742	257.1645	155.7084	109.2439	(83)
Total gains	504.6416	601.1927	692.8913	786.6169	851.1647	840.4023	800.9292	740.0155	670.5429	577.4012	501.2869	473.8252	(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	33.8569	33.9379	34.0176	34.3973	34.4693	34.8084	34.8084	34.8719	34.6770	34.4693	34.3240	34.1734	
alpha	3.2571	3.2625	3.2678	3.2932	3.2980	3.3206	3.3206	3.3248	3.3118	3.2980	3.2883	3.2782	
util living area													
	0.9847	0.9724	0.9472	0.8897	0.7842	0.6318	0.4903	0.5420	0.7599	0.9229	0.9747	0.9874	(86)
MIT	19.0804	19.3337	19.7246	20.2137	20.6197	20.8704	20.9583	20.9415	20.7486	20.2100	19.5547	19.0344	(87)
Th 2	19.9094	19.9118	19.9140	19.9247	19.9267	19.9360	19.9360	19.9377	19.9324	19.9267	19.9226	19.9184	(88)
util rest of house													
	0.9815	0.9667	0.9360	0.8656	0.7366	0.5518	0.3837	0.4340	0.6909	0.9008	0.9685	0.9848	(89)
MIT 2	17.3582	17.7259	18.2889	18.9834	19.5254	19.8307	19.9137	19.9037	19.7027	18.9948	18.0566	17.2969	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	17.7896	18.1287	18.6485	19.2916	19.7995	20.0911	20.1753	20.1637	19.9647	19.2992	18.4319	17.7321	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6396	17.9787	18.4985	19.1416	19.6495	19.9411	20.0253	20.0137	19.8147	19.1492	18.2819	17.5821	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9714	0.9523	0.9165	0.8441	0.7226	0.5523	0.3931	0.4422	0.6821	0.8800	0.9548	0.9760	(94)
Useful gains	490.2216	572.4882	635.0597	663.9675	615.0701	464.1254	314.8334	327.2525	457.4019	508.0870	478.6447	462.4726	(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													
	1299.8768	1271.4089	1163.6740	982.3154	760.8796	506.2380	324.6585	341.8857	543.7014	818.2746	1074.7909	1291.9461	(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													
	602.3834	469.6747	393.2890	229.2105	108.4823	0.0000	0.0000	0.0000	0.0000	230.7796	429.2253	617.1283	(98)
Space heating												3080.1731	(98)
Space heating per m2											(98) / (4) =	38.3488	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3403.5062	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	602.3834	469.6747	393.2890	229.2105	108.4823	0.0000	0.0000	0.0000	0.0000	230.7796	429.2253	617.1283	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	665.6171	518.9775	434.5735	253.2713	119.8699	0.0000	0.0000	0.0000	0.0000	255.0051	474.2821	681.9097	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7886	89.7214	89.5877	89.2967	88.7341	87.3000	87.3000	87.3000	87.3000	89.2738	89.6523	89.8177	(217)
Fuel for water heating, kWh/month													
	185.0039	162.3733	168.8660	149.2135	145.2117	129.0595	121.2740	136.7748	137.7020	154.9103	166.4359	179.6078	(219)
Water heating fuel used												1836.4327	(219)
Annual totals kWh/year													
Space heating fuel - main system												3403.5062	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4451.7476	(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	3403.5062	0.2160	735.1573	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1836.4327	0.2160	396.6695	(264)
Space and water heating			1131.8268	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			722.7555	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.0000	(273)

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

DER		9.0000	ZC1
Total Floor Area	TFA	80.3200	
Assumed number of occupants	N	2.4689	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2390	ZC2
CO2 emissions from cooking, equation (L16)		2.2193	ZC3
Total CO2 emissions		27.4583	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.4583	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(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	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1100	1.3258	18.7064			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.1800	13.7628			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0408			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.8721	(36)
Total fabric heat loss (33) + (36) =	54.9129	(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	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.5870	96.2990	96.0168	94.6910	94.4430	93.2883	93.2883	93.0745	93.7331	94.4430	94.9448	95.4694	(39)
Average = Sum(39)m / 12 =												94.6899	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1989	1.1954	1.1789	1.1758	1.1615	1.1615	1.1588	1.1670	1.1758	1.1821	1.1886	(40)
HLP (average)												1.1789	(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	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(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													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.2940	48.2546	44.8667	44.4699	41.2041	42.5776	44.4699	44.8667	48.2546	48.5293	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(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													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
								Total per year (kWh/year) = Sum(64)m =				2015.3850	(64)
Heat gains from water heating, kWh/month													
	63.0939	55.3636	57.5091	50.8371	49.1342	43.1066	41.0436	46.0010	46.5168	53.2026	57.0387	61.5051	(65)

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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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	84.8037	82.3863	77.2972	70.6071	66.0407	59.8703	55.1661	61.8293	64.6067	71.5088	79.2203	82.6681	(72)
Total internal gains													
	388.0676	385.6844	371.5020	349.0277	326.2155	304.2267	290.3700	296.9990	308.8697	331.5560	357.5134	376.7795	(73)

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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	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	8.0100	36.7938	0.6300	0.7000	0.7700	90.0698	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	111.1039	196.2378	287.0590	386.7858	461.6243	470.7747	448.6799	390.9377	321.2941	221.8882	134.3492	94.2585	(83)
Total gains	499.1715	581.9222	658.5609	735.8135	787.8398	775.0014	739.0499	687.9367	630.1639	553.4443	491.8626	471.0380	(84)

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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	57.7488	57.9214	58.0917	58.9050	59.0597	59.7907	59.7907	59.9281	59.5070	59.0597	58.7476	58.4248	
alpha	4.8499	4.8614	4.8728	4.9270	4.9373	4.9860	4.9860	4.9952	4.9671	4.9373	4.9165	4.8950	
util living area													
	0.9977	0.9947	0.9861	0.9565	0.8734	0.7094	0.5418	0.5990	0.8430	0.9734	0.9951	0.9982	(86)
MIT	19.7086	19.8740	20.1386	20.4859	20.7786	20.9449	20.9883	20.9812	20.8654	20.4839	20.0348	19.6837	(87)
Th 2	19.9180	19.9208	19.9237	19.9369	19.9394	19.9510	19.9510	19.9531	19.9465	19.9394	19.9344	19.9291	(88)
util rest of house													
	0.9969	0.9928	0.9811	0.9400	0.8264	0.6166	0.4196	0.4742	0.7695	0.9602	0.9931	0.9976	(89)
MIT 2	18.2032	18.4462	18.8319	19.3348	19.7227	19.9145	19.9467	19.9454	19.8387	19.3417	18.6913	18.1746	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.5803	18.8039	19.1592	19.6231	19.9872	20.1726	20.2076	20.2049	20.0959	19.6278	19.0278	18.5526	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5803	18.8039	19.1592	19.6231	19.9872	20.1726	20.2076	20.2049	20.0959	19.6278	19.0278	18.5526	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9901	0.9762	0.9339	0.8288	0.6376	0.4504	0.5056	0.7815	0.9550	0.9906	0.9965	(94)
Useful gains	496.8621	576.1520	642.9019	687.1480	652.9815	494.1282	332.8875	347.7897	492.4534	528.5362	487.2191	469.3749	(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													
	1379.2889	1338.9273	1215.4942	1015.3837	782.6713	519.8569	336.5495	354.1402	562.0135	852.6153	1132.4852	1370.2332	(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													
	656.5255	512.5850	426.0086	236.3297	96.4892	0.0000	0.0000	0.0000	0.0000	241.1149	464.5916	670.2386	(98)
Space heating												3303.8831	(98)
Space heating per m2											(98) / (4) =	41.1340	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3537.3481	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	656.5255	512.5850	426.0086	236.3297	96.4892	0.0000	0.0000	0.0000	0.0000	241.1149	464.5916	670.2386	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	702.9181	548.8062	456.1120	253.0296	103.3075	0.0000	0.0000	0.0000	0.0000	258.1530	497.4214	717.6002	(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													
	202.4001	177.7455	184.9327	164.0260	158.8061	139.8675	134.0037	149.3828	151.0325	171.9806	183.5859	197.6216	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7978	87.5642	87.0844	85.9698	83.8403	80.3000	80.3000	80.3000	80.3000	85.9018	87.2903	87.8829	(217)
Fuel for water heating, kWh/month													
	230.5299	202.9887	212.3602	190.7947	189.4149	174.1812	166.8789	186.0308	188.0853	200.2060	210.3165	224.8692	(219)
Water heating fuel used												2376.6565	(219)
Annual totals kWh/year													
Space heating fuel - main system												3537.3481	(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)												355.3658	(232)
Total delivered energy for all uses												6344.3703	(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	3537.3481	0.2160	764.0672	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2376.6565	0.2160	513.3578	(264)
Space and water heating			1277.4250	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Total CO2, kg/m2/year			1500.7848	(272)
Emissions per m2 for space and water heating			15.9042	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2963	(272b)
Emissions per m2 for pumps and fans			0.4846	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9042 * 1.00) + 2.2963 + 0.4846, rounded to 2 d.p.			18.6900	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		4.2000	
Infiltration rate		0.3545	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335 (36)
Total fabric heat loss	(33) + (36) =	57.1986 (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	40.2465	40.0139	39.7860	38.7155	38.5152	37.5828	37.5828	37.4102	37.9420	38.5152	38.9204	39.3440	(38)
Heat transfer coeff	97.4450	97.2125	96.9846	95.9141	95.7138	94.7814	94.7814	94.6087	95.1405	95.7138	96.1190	96.5426	(39)
Average = Sum(39)m / 12 =												95.9131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2132	1.2103	1.2075	1.1941	1.1917	1.1800	1.1800	1.1779	1.1845	1.1917	1.1967	1.2020	(40)
HLP (average)												1.1941	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.5183	342.1819	330.2425	310.5891	289.8313	270.4758	258.3169	262.1348	272.5967	292.3856	315.1535	333.0010	(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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	128.7675	227.4361	332.6962	448.2778	535.0143	545.6195	520.0119	453.0898	372.3742	257.1645	155.7084	109.2439	(83)
Total gains	472.2857	569.6180	662.9388	758.8669	824.8456	816.0953	778.3288	715.2246	644.9708	549.5501	470.8618	442.2449	(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	33.8569	33.9379	34.0176	34.3973	34.4693	34.8084	34.8084	34.8719	34.6770	34.4693	34.3240	34.1734	
alpha	3.2571	3.2625	3.2678	3.2932	3.2980	3.3206	3.3206	3.3248	3.3118	3.2980	3.2883	3.2782	
util living area													
	0.9873	0.9762	0.9528	0.8981	0.7957	0.6447	0.5022	0.5568	0.7748	0.9315	0.9788	0.9897	(86)
MIT	19.0284	19.2851	19.6826	20.1825	20.6006	20.8621	20.9552	20.9366	20.7318	20.1742	19.5073	18.9830	(87)
Th 2	19.9094	19.9118	19.9140	19.9247	19.9267	19.9360	19.9360	19.9377	19.9324	19.9267	19.9226	19.9184	(88)
util rest of house													
	0.9846	0.9712	0.9426	0.8753	0.7492	0.5646	0.3939	0.4473	0.7074	0.9114	0.9735	0.9875	(89)
MIT 2	18.1162	18.3718	18.7642	19.2536	19.6373	19.8590	19.9195	19.9123	19.7636	19.2575	18.6023	18.0776	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.3447	18.6006	18.9943	19.4863	19.8786	20.1103	20.1789	20.1689	20.0061	19.4871	18.8290	18.3044	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3447	18.6006	18.9943	19.4863	19.8786	20.1103	20.1789	20.1689	20.0061	19.4871	18.8290	18.3044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9793	0.9632	0.9317	0.8643	0.7469	0.5787	0.4198	0.4726	0.7126	0.9011	0.9662	0.9829	(94)
Useful gains	462.5114	548.6513	617.6556	655.8817	616.0567	472.2912	326.7325	337.9827	459.6202	495.1854	454.9531	434.7021	(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													
	1368.5835	1331.8712	1211.7527	1015.3749	782.8073	522.2707	339.2175	356.5716	561.9101	850.6195	1127.3796	1361.6792	(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													
	674.1177	526.3238	442.0082	258.8351	124.0625	0.0000	0.0000	0.0000	0.0000	264.4429	484.1470	689.6710	(98)
Space heating												3463.6082	(98)
Space heating per m2											(98) / (4) =	43.1226	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	890.9451	701.3823	719.0264	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8260	0.8827	0.8557	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	735.9519	619.1332	615.2766	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1046.1441	1000.1098	927.9568	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	223.3384	283.4466	232.6341	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												739.4191	(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	55.8346	70.8616	58.1585	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												184.8548	(107)
Space cooling per m2												2.3015	(108)
Energy for space heating												43.1226	(99)
Energy for space cooling												2.3015	(108)
Total												45.4241	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.4	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1445	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3945	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3649	(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	0.4653	0.4561	0.4470	0.4014	0.3923	0.3467	0.3467	0.3375	0.3649	0.3923	0.4105	0.4288	(22b)
Effective ac	0.6082	0.6040	0.5999	0.5806	0.5769	0.5601	0.5601	0.5570	0.5666	0.5769	0.5843	0.5919	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1100	1.3258	18.7064			(27)
GF B&B J150 P/A=0.40			40.1600	0.1300	5.2208			(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.1800	13.7628			(29a)
Plane Ceiling	40.1600		40.1600	0.1300	5.2208			(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0408			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.8721	(36)
Total fabric heat loss (33) + (36) =	54.9129	(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	41.6740	41.3861	41.1038	39.7781	39.5301	38.3754	38.3754	38.1616	38.8201	39.5301	40.0318	40.5564	(38)
Heat transfer coeff	96.5870	96.2990	96.0168	94.6910	94.4430	93.2883	93.2883	93.0745	93.7331	94.4430	94.9448	95.4694	(39)
Average = Sum(39)m / 12 =												94.6899	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2025	1.1989	1.1954	1.1789	1.1758	1.1615	1.1615	1.1588	1.1670	1.1758	1.1821	1.1886	(40)
HLP (average)												1.1789	(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	2.4689	(42)
Average daily hot water use (litres/day)	92.8365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)
Energy content (annual)										Total = Sum(45)m =		1460.6794	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.1813	28.1459	29.0441	25.3213	24.2964	20.9660	19.4280	22.2940	22.5602	26.2918	28.6995	31.1658	(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	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	123.4452	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.1223	17.8724	14.5348	11.0038	8.2255	6.9443	7.5036	9.7534	13.0910	16.6220	19.4004	20.6815	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	220.1080	222.3921	216.6364	204.3832	188.9158	174.3786	164.6668	162.3828	168.1385	180.3916	195.8591	210.3963	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	35.3445	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	43.2544	41.8838	39.0377	35.1685	32.6565	29.1194	26.1130	29.9650	31.3337	35.3384	39.8605	41.8896	(72)
Total internal gains													
	343.5183	342.1819	330.2425	310.5891	289.8313	270.4758	258.3169	262.1348	272.5967	292.3856	315.1535	333.0010	(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	
Northeast	3.6300	11.2829	0.6300	0.7000	0.7700	12.5170	(75)
Southwest	8.0100	36.7938	0.6300	0.7000	0.7700	90.0698	(79)
Northwest	2.4700	11.2829	0.6300	0.7000	0.7700	8.5171	(81)

Solar gains	111.1039	196.2378	287.0590	386.7858	461.6243	470.7747	448.6799	390.9377	321.2941	221.8882	134.3492	94.2585	(83)
Total gains	454.6222	538.4197	617.3015	697.3749	751.4556	741.2506	706.9968	653.0725	593.8908	514.2739	449.5027	427.2595	(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	57.7488	57.9214	58.0917	58.9050	59.0597	59.7907	59.7907	59.9281	59.5070	59.0597	58.7476	58.4248	
alpha	4.8499	4.8614	4.8728	4.9270	4.9373	4.9860	4.9860	4.9952	4.9671	4.9373	4.9165	4.8950	
util living area													
	0.9985	0.9962	0.9893	0.9642	0.8893	0.7321	0.5637	0.6258	0.8658	0.9800	0.9967	0.9989	(86)
MIT	19.6576	19.8248	20.0937	20.4494	20.7555	20.9365	20.9861	20.9773	20.8455	20.4435	19.9866	19.6333	(87)
Th 2	19.9180	19.9208	19.9237	19.9369	19.9394	19.9510	19.9510	19.9531	19.9465	19.9394	19.9344	19.9291	(88)
util rest of house													
	0.9979	0.9948	0.9854	0.9501	0.8457	0.6396	0.4379	0.4979	0.7973	0.9697	0.9953	0.9985	(89)
MIT 2	18.6963	18.8652	19.1344	19.4920	19.7734	19.9217	19.9475	19.9466	19.8596	19.4932	19.0379	18.6809	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.9371	19.1056	19.3747	19.7318	20.0194	20.1759	20.2076	20.2048	20.1066	19.7313	19.2756	18.9194	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9371	19.1056	19.3747	19.7318	20.0194	20.1759	20.2076	20.2048	20.1066	19.7313	19.2756	18.9194	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9935	0.9827	0.9468	0.8496	0.6611	0.4698	0.5303	0.8094	0.9670	0.9941	0.9979	(94)
Useful gains	453.3631	534.8956	606.6385	660.2406	638.4009	490.0185	332.1431	346.3094	480.7181	497.3145	446.8504	426.3832	(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													
	1413.7524	1367.9842	1236.1844	1025.6775	785.7122	520.1693	336.5502	354.1309	563.0157	862.3853	1156.0056	1405.2566	(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													
	714.5297	559.8355	468.3821	263.1146	109.5996	0.0000	0.0000	0.0000	0.0000	271.6127	510.5917	728.2818	(98)
Space heating												3625.9478	(98)
Space heating per m2											(98) / (4) =	45.1438	(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	876.9103	690.3336	707.3662	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8678	0.9265	0.9015	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	760.9493	639.5992	637.6587	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	958.6632	916.7346	855.3115	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	142.3540	206.1888	161.9337	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												510.4765	(104)

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	35.5885	51.5472	40.4834	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.6191 (107)
Space cooling per m2												1.5889 (108)
Energy for space heating												45.1438 (99)
Energy for space cooling												1.5889 (108)
Total												46.7327 (109)
Target Fabric Energy Efficiency (TFEE)												53.7 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.2000	
Infiltration rate			0.3545	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3443	0.3197	0.3279	0.3115	0.3115	0.3033	0.2951	0.2869	0.2787	0.3033	0.2869	0.3033	(22b)
Effective ac	0.5593	0.5511	0.5538	0.5485	0.5485	0.5460	0.5435	0.5412	0.5388	0.5460	0.5412	0.5460	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	38.3195	37.7601	37.9420	37.5828	37.5828	37.4102	37.2421	37.0787	36.9198	37.4102	37.0787	37.4102	(38)
Heat transfer coeff	95.5181	94.9587	95.1405	94.7814	94.7814	94.6087	94.4407	94.2772	94.1184	94.6087	94.2772	94.6087	(39)
Average = Sum(39)m / 12 =												94.6766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1892	1.1823	1.1845	1.1800	1.1800	1.1779	1.1758	1.1738	1.1718	1.1779	1.1738	1.1779	(40)
HLP (average)												1.1787	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
											Total per year (kWh/year) = Sum(64)m =	1632.1614	(64)
RHI water heating demand												1632	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585	(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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	159.7591	240.8422	357.1980	487.6193	555.5130	616.2529	582.4025	518.3817	423.4578	294.3774	192.6923	133.1539	(83)
Total gains	715.8549	792.5707	887.5237	984.7573	1018.6765	1048.9669	997.3065	941.5439	865.7044	770.0237	705.4661	674.0123	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5399	34.7434	34.6770	34.8084	34.8084	34.8719	34.9339	34.9945	35.0536	34.8719	34.9945	34.8719	
alpha	3.3027	3.3162	3.3118	3.3206	3.3206	3.3248	3.3289	3.3330	3.3369	3.3248	3.3330	3.3248	
util living area													
	0.9556	0.9383	0.8947	0.8059	0.6718	0.4851	0.3607	0.3800	0.6092	0.8278	0.9273	0.9612	(86)
MIT	19.5409	19.7208	20.0797	20.4923	20.7921	20.9479	20.9853	20.9830	20.8875	20.5357	20.0032	19.5157	(87)
Th 2	19.9286	19.9342	19.9324	19.9360	19.9360	19.9377	19.9394	19.9410	19.9426	19.9377	19.9410	19.9377	(88)
util rest of house													
	0.9470	0.9268	0.8750	0.7703	0.6131	0.4046	0.2664	0.2814	0.5288	0.7868	0.9111	0.9535	(89)
MIT 2	18.0323	18.2914	18.7950	19.3573	19.7346	19.9016	19.9332	19.9337	19.8531	19.4309	18.7034	18.0031	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.4102	18.6495	19.1168	19.6416	19.9995	20.1637	20.1967	20.1965	20.1122	19.7076	19.0290	18.3820	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2602	18.4995	18.9668	19.4916	19.8495	20.0137	20.0467	20.0465	19.9622	19.5576	18.8790	18.2320	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9290	0.9067	0.8532	0.7533	0.6079	0.4106	0.2762	0.2915	0.5304	0.7697	0.8905	0.9367	(94)
Useful gains	665.0609	718.6043	757.2478	741.8302	619.2808	430.6544	275.4155	274.4257	459.1888	592.6501	628.1879	631.3695	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1276.1423	1253.4024	1138.5277	947.0206	696.5985	445.9535	278.2917	277.7924	495.2672	771.7834	1035.0704	1251.8654	(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													
	454.6446	359.3843	283.6722	147.7371	57.5244	0.0000	0.0000	0.0000	0.0000	133.2752	292.9554	461.6490	(98)
Space heating												2190.8422	(98)
RHI space heating demand												2191	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.2000	
Infiltration rate				0.3545	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	40.2465	40.0139	39.7860	38.7155	38.5152	37.5828	37.5828	37.4102	37.9420	38.5152	38.9204	39.3440	(38)
Heat transfer coeff	97.4450	97.2125	96.9846	95.9141	95.7138	94.7814	94.7814	94.6087	95.1405	95.7138	96.1190	96.5426	(39)
Average = Sum(39)m / 12 =												95.9131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2132	1.2103	1.2075	1.1941	1.1917	1.1800	1.1800	1.1779	1.1845	1.1917	1.1967	1.2020	(40)
HLP (average)												1.1941	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)

Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (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

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)

Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (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)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)

Total internal gains

	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585 (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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	128.7675	227.4361	332.6962	448.2778	535.0143	545.6195	520.0119	453.0898	372.3742	257.1645	155.7084	109.2439 (83)
Total gains	684.8633	779.1646	863.0219	945.4158	998.1778	978.3335	934.9159	876.2520	814.6208	732.8108	668.4822	650.1024 (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	33.8569	33.9379	34.0176	34.3973	34.4693	34.8084	34.8084	34.8719	34.6770	34.4693	34.3240	34.1734	
alpha	3.2571	3.2625	3.2678	3.2932	3.2980	3.3206	3.3206	3.3248	3.3118	3.2980	3.2883	3.2782	
util living area	0.9646	0.9456	0.9105	0.8388	0.7216	0.5649	0.4286	0.4710	0.6795	0.8687	0.9460	0.9695	(86)
MIT	19.3583	19.5923	19.9448	20.3727	20.7100	20.9075	20.9720	20.9615	20.8238	20.3872	19.7998	19.3110	(87)
Th 2	19.9094	19.9118	19.9140	19.9247	19.9267	19.9360	19.9360	19.9377	19.9324	19.9267	19.9226	19.9184	(88)
util rest of house	0.9577	0.9354	0.8935	0.8080	0.6697	0.4873	0.3320	0.3722	0.6059	0.8366	0.9340	0.9635	(89)
MIT 2	17.7577	18.0935	18.5942	19.1910	19.6291	19.8632	19.9215	19.9162	19.7787	19.2273	18.4035	17.6955	(90)

Living area fraction fLA = Living area / (4) = 0.2505 (91)

MIT	18.1586	18.4689	18.9325	19.4870	19.8998	20.1248	20.1847	20.1781	20.0405	19.5178	18.7533	18.1002	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0086	18.3189	18.7825	19.3370	19.7498	19.9748	20.0347	20.0281	19.8905	19.3678	18.6033	17.9502	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9413	0.9157	0.8714	0.7885	0.6602	0.4903	0.3413	0.3810	0.6027	0.8164	0.9145	0.9484	(94)
Useful gains	644.6478	713.4578	752.0317	745.4663	659.0228	479.6942	319.0868	333.8256	490.9904	598.2704	611.3531	616.5778	(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

	1335.8378	1304.4876	1191.2123	1001.0579	770.4802	509.4346	325.5423	343.2455	550.9138	839.2035	1105.6812	1327.4785	(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

	514.2453	397.1720	326.7504	184.0260	82.9243	0.0000	0.0000	0.0000	0.0000	179.2542	355.9163	528.9101	(98)

Space heating 2569.1986 (98)

Space heating per m2 (98) / (4) = 31.9870 (99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2838.8935	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	514.2453	397.1720	326.7504	184.0260	82.9243	0.0000	0.0000	0.0000	0.0000	179.2542	355.9163	528.9101	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	568.2269	438.8641	361.0501	203.3436	91.6290	0.0000	0.0000	0.0000	0.0000	198.0710	393.2776	584.4311	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6973	89.6184	89.4622	89.1280	88.5257	87.3000	87.3000	87.3000	87.3000	89.0780	89.5306	89.7313	(217)
Fuel for water heating, kWh/month													
	185.1923	162.5598	169.1029	149.4960	145.5537	129.0595	121.2740	136.7748	137.7020	155.2509	166.6622	179.7808	(219)
Water heating fuel used												1838.4090	(219)
Annual totals kWh/year													
Space heating fuel - main system												2838.8935	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3889.1112	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2838.8935	3.4800	98.7935	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1838.4090	3.4800	63.9766	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	355.3658	13.1900	46.8727	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			178.8077	(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] =	0.5993	(257)
SAP value		91.6403	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	2838.8935	0.2160	613.2010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1838.4090	0.2160	397.0963	(264)
Space and water heating			1010.2973	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			601.2261	(272)
CO2 emissions per m2			7.4900	(273)
EI value			93.5713	
EI rating			94	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8866 = 0.2436, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1445	(8)
Pressure test			Yes	
Measured/design AP50			4.2000	
Infiltration rate			0.3545	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3443	0.3197	0.3279	0.3115	0.3115	0.3033	0.2951	0.2869	0.2787	0.3033	0.2869	0.3033	(22b)
Effective ac	0.5593	0.5511	0.5538	0.5485	0.5485	0.5460	0.5435	0.5412	0.5388	0.5460	0.5412	0.5460	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	38.3195	37.7601	37.9420	37.5828	37.5828	37.4102	37.2421	37.0787	36.9198	37.4102	37.0787	37.4102	(38)
Heat transfer coeff	95.5181	94.9587	95.1405	94.7814	94.7814	94.6087	94.4407	94.2772	94.1184	94.6087	94.2772	94.6087	(39)
Average = Sum(39)m / 12 =												94.6766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1892	1.1823	1.1845	1.1800	1.1800	1.1779	1.1758	1.1738	1.1718	1.1779	1.1738	1.1779	(40)
HLP (average)												1.1787	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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

Energy content (annual) Total = Sum(45)m = 1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569 (61)

Total heat required for water heating calculated for each month

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (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

	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196 (64)

Total per year (kWh/year) = Sum(64)m = 1632.1614 (64)
Heat gains from water heating, kWh/month

	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296 (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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823 (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)

	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562 (71)

Water heating gains (Table 5)

	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699 (72)
Total internal gains												
	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585 (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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	159.7591	240.8422	357.1980	487.6193	555.5130	616.2529	582.4025	518.3817	423.4578	294.3774	192.6923	133.1539 (83)
Total gains	715.8549	792.5707	887.5237	984.7573	1018.6765	1048.9669	997.3065	941.5439	865.7044	770.0237	705.4661	674.0123 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5399	34.7434	34.6770	34.8084	34.8084	34.8719	34.9339	34.9945	35.0536	34.8719	34.9945	34.8719	
alpha	3.3027	3.3162	3.3118	3.3206	3.3206	3.3248	3.3289	3.3330	3.3369	3.3248	3.3330	3.3248	
util living area													
	0.9556	0.9383	0.8947	0.8059	0.6718	0.4851	0.3607	0.3800	0.6092	0.8278	0.9273	0.9612	(86)
MIT	19.5409	19.7208	20.0797	20.4923	20.7921	20.9479	20.9853	20.9830	20.8875	20.5357	20.0032	19.5157	(87)
Th 2	19.9286	19.9342	19.9324	19.9360	19.9360	19.9377	19.9394	19.9410	19.9426	19.9377	19.9410	19.9377	(88)
util rest of house													
	0.9470	0.9268	0.8750	0.7703	0.6131	0.4046	0.2664	0.2814	0.5288	0.7868	0.9111	0.9535	(89)
MIT 2	18.0323	18.2914	18.7950	19.3573	19.7346	19.9016	19.9332	19.9337	19.8531	19.4309	18.7034	18.0031	(90)
Living area fraction									fLA = Living area / (4) =			0.2505	(91)
MIT	18.4102	18.6495	19.1168	19.6416	19.9995	20.1637	20.1967	20.1965	20.1122	19.7076	19.0290	18.3820	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2602	18.4995	18.9668	19.4916	19.8495	20.0137	20.0467	20.0465	19.9622	19.5576	18.8790	18.2320	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9290	0.9067	0.8532	0.7533	0.6079	0.4106	0.2762	0.2915	0.5304	0.7697	0.8905	0.9367	(94)
Useful gains	665.0609	718.6043	757.2478	741.8302	619.2808	430.6544	275.4155	274.4257	459.1888	592.6501	628.1879	631.3695	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1276.1423	1253.4024	1138.5277	947.0206	696.5985	445.9535	278.2917	277.7924	495.2672	771.7834	1035.0704	1251.8654	(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													
	454.6446	359.3843	283.6722	147.7371	57.5244	0.0000	0.0000	0.0000	0.0000	133.2752	292.9554	461.6490	(98)
Space heating												2190.8422	(98)
Space heating per m2											(98) / (4) =	27.2764	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.8201	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	454.6446	359.3843	283.6722	147.7371	57.5244	0.0000	0.0000	0.0000	0.0000	133.2752	292.9554	461.6490	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	502.3697	397.1097	313.4500	163.2454	63.5629	0.0000	0.0000	0.0000	0.0000	147.2655	323.7076	510.1094	(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													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6209	89.5532	89.3607	88.9538	88.2633	87.3000	87.3000	87.3000	87.3000	88.8417	89.3942	89.6491	(217)
Fuel for water heating, kWh/month													
	185.3501	162.6783	169.2950	149.7887	145.9864	129.0595	121.2740	136.7748	137.7020	155.6639	166.9164	179.9457	(219)
Water heating fuel used												1840.4348	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.8201	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3322.6435	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.8201	10.2300	247.6499	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1840.4348	10.2300	188.2765	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	355.3658	36.7200	130.4903	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			194.2683	(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	2420.8201	0.2160	522.8971	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4348	0.2160	397.5339	(264)
Space and water heating			920.4311	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			433.2918	(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	2420.8201	1.2200	2953.4005	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1840.4348	1.2200	2245.3305	(264)
Space and water heating			5198.7310	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	355.3658	3.0700	1090.9729	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2317.1941	(272)
Primary energy kWh/m2/year			28.8495	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 82	-185 kg (42.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£82	2.31 kg/m²	A 93	A 95
Total Savings	£82	2.31 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£158	£176	-£18
Mains gas	£539	£439	£100
Space heating	£378	£378	£0
Water heating	£188	£107	£82
Lighting	£130	£130	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£194	£112	£82
Total cost of uses	£193	£112	£82
Delivered energy	41 kWh/m²	30 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	16 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600	(1b)	x 2.5400	(2b) =	102.0064	(1b) - (3b)
First floor	40.1600	(1c)	x 2.6300	(2c) =	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.2000	
Infiltration rate				0.3545	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	40.2465	40.0139	39.7860	38.7155	38.5152	37.5828	37.5828	37.4102	37.9420	38.5152	38.9204	39.3440	(38)
Heat transfer coeff	97.4450	97.2125	96.9846	95.9141	95.7138	94.7814	94.7814	94.6087	95.1405	95.7138	96.1190	96.5426	(39)
Average = Sum(39)m / 12 =												95.9131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2132	1.2103	1.2075	1.1941	1.1917	1.1800	1.1800	1.1779	1.1845	1.1917	1.1967	1.2020	(40)
HLP (average)												1.1941	(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	2.4689 (42)
Average daily hot water use (litres/day)	92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1460.6794 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)
Total heat required for water heating calculated for each month													
	166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(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												1.2416	(H8)
Utilisation factor												0.5531	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-844.3736	(H17)
Solar input	-24.4852	-40.8587	-69.5870	-93.2603	-115.2152	-113.2749	-111.7780	-97.6610	-76.4881	-52.2324	-29.0429	-20.4899	(63)
										Solar input (sum of months) = Sum(63)m =		-844.3736	(63)
Output from w/h													
	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
										Total per year (kWh/year) = Sum(64)m =		794.2995	(64)
Heat gains from water heating, kWh/month													
	54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)

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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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585	(73)

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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	
Northeast	3.6300	11.2829	0.4600	0.0000	0.7700	14.5070	(75)
Southwest	4.6800	36.7938	0.4600	0.0000	0.7700	60.9915	(79)
Northwest	2.4700	11.2829	0.4600	0.0000	0.7700	9.8712	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	128.7675	227.4361	332.6962	448.2778	535.0143	545.6195	520.0119	453.0898	372.3742	257.1645	155.7084	109.2439	(83)
Total gains	684.8633	779.1646	863.0219	945.4158	998.1778	978.3335	934.9159	876.2520	814.6208	732.8108	668.4822	650.1024	(84)

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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	33.8569	33.9379	34.0176	34.3973	34.4693	34.8084	34.8084	34.8719	34.6770	34.4693	34.3240	34.1734	
alpha	3.2571	3.2625	3.2678	3.2932	3.2980	3.3206	3.3206	3.3248	3.3118	3.2980	3.2883	3.2782	
util living area													
	0.9646	0.9456	0.9105	0.8388	0.7216	0.5649	0.4286	0.4710	0.6795	0.8687	0.9460	0.9695	(86)
MIT	19.3583	19.5923	19.9448	20.3727	20.7100	20.9075	20.9720	20.9615	20.8238	20.3872	19.7998	19.3110	(87)
Th 2	19.9094	19.9118	19.9140	19.9247	19.9267	19.9360	19.9360	19.9377	19.9324	19.9267	19.9226	19.9184	(88)
util rest of house													
	0.9577	0.9354	0.8935	0.8080	0.6697	0.4873	0.3320	0.3722	0.6059	0.8366	0.9340	0.9635	(89)
MIT 2	17.7577	18.0935	18.5942	19.1910	19.6291	19.8632	19.9215	19.9162	19.7787	19.2273	18.4035	17.6955	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.1586	18.4689	18.9325	19.4870	19.8998	20.1248	20.1847	20.1781	20.0405	19.5178	18.7533	18.1002	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0086	18.3189	18.7825	19.3370	19.7498	19.9748	20.0347	20.0281	19.8905	19.3678	18.6033	17.9502	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9413	0.9157	0.8714	0.7885	0.6602	0.4903	0.3413	0.3810	0.6027	0.8164	0.9145	0.9484	(94)
Useful gains	644.6478	713.4578	752.0317	745.4663	659.0228	479.6942	319.0868	333.8256	490.9904	598.2704	611.3531	616.5778	(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	1335.8378	1304.4876	1191.2123	1001.0579	770.4802	509.4346	325.5423	343.2455	550.9138	839.2035	1105.6812	1327.4785	(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	514.2453	397.1720	326.7504	184.0260	82.9243	0.0000	0.0000	0.0000	0.0000	179.2542	355.9163	528.9101	(98)
Space heating												2569.1986	(98)
Space heating per m2											(98) / (4) =	31.9870	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2838.8935	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	514.2453	397.1720	326.7504	184.0260	82.9243	0.0000	0.0000	0.0000	0.0000	179.2542	355.9163	528.9101	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	568.2269	438.8641	361.0501	203.3436	91.6290	0.0000	0.0000	0.0000	0.0000	198.0710	393.2776	584.4311	(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	141.6273	104.8249	81.6962	39.9825	13.6371	0.0000	0.0000	21.7434	43.7257	86.0620	120.1707	140.8297	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7893	89.8126	89.8413	89.9118	90.0339	87.3000	87.3000	87.3000	87.3000	89.4366	89.6703	89.8078	(217)
Fuel for water heating, kWh/month	157.7329	116.7152	90.9339	44.4685	15.1466	0.0000	0.0000	24.9065	50.0868	96.2268	134.0139	156.8124	(219)
Water heating fuel used												887.0436	(219)
Annual totals kWh/year													
Space heating fuel - main system												2838.8935	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												2987.7458	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2838.8935	3.4800	98.7935	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	887.0436	3.4800	30.8691	(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	355.3658	13.1900	46.8727	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			152.2952	(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] =	0.5104	(257)
SAP value	92.8798	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2838.8935	0.2160	613.2010	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	887.0436	0.2160	191.6014	(264)
Space and water heating			804.8024	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			421.6811	(272)
CO2 emissions per m2			5.2500	(273)
EI value			95.4911	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.1600 (1b)	x	2.5400 (2b)	=	102.0064	(1b) - (3b)
First floor	40.1600 (1c)	x	2.6300 (2c)	=	105.6208	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.3200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.6272	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1445	(8)
Pressure test				Yes	
Measured/design AP50				4.2000	
Infiltration rate				0.3545	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3443	0.3197	0.3279	0.3115	0.3115	0.3033	0.2951	0.2869	0.2787	0.3033	0.2869	0.3033	(22b)
Effective ac	0.5593	0.5511	0.5538	0.5485	0.5485	0.5460	0.5435	0.5412	0.5388	0.5460	0.5412	0.5460	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.7800	1.2357	13.3213			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			40.1600	0.1200	4.8192	75.0000	3012.0000	(28a)
EW Brick AAC015	92.7000	16.2400	76.4600	0.2500	19.1150	52.3000	3998.8580	(29a)
Plane Ceiling	40.1600		40.1600	0.1600	6.4256	9.0000	361.4400	(30)
Total net area of external elements Aum(A, m2)			173.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.5651			(33)
E-WM-30			47.7700	0.0000	0.0000	45.0000	2149.6500	(32)
GF Timber			65.5800			9.0000	590.2200	(32c)
1F Timber			75.6200			9.0000	680.5800	(32c)
Internal Floor			40.1600			18.0000	722.8800	(32d)
Internal Ceiling			40.1600			9.0000	361.4400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11877.0680	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.8719	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.6335	(36)
Total fabric heat loss	(33) + (36) =	57.1986	(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	38.3195	37.7601	37.9420	37.5828	37.5828	37.4102	37.2421	37.0787	36.9198	37.4102	37.0787	37.4102	(38)
Heat transfer coeff	95.5181	94.9587	95.1405	94.7814	94.7814	94.6087	94.4407	94.2772	94.1184	94.6087	94.2772	94.6087	(39)
Average = Sum(39)m / 12 =												94.6766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1892	1.1823	1.1845	1.1800	1.1800	1.1779	1.1758	1.1738	1.1718	1.1779	1.1738	1.1779	(40)
HLP (average)												1.1787	(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		2.4689 (42)
Average daily hot water use (litres/day)		92.8365 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.1201	98.4067	94.6932	90.9798	87.2663	83.5528	83.5528	87.2663	90.9798	94.6932	98.4067	102.1201	(44)
Energy conte	151.4412	132.4515	136.6780	119.1592	114.3361	98.6634	91.4261	104.9128	106.1658	123.7260	135.0566	146.6627	(45)

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

Energy content (annual)											Total = Sum(45)m =	1460.6794	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.7162	19.8677	20.5017	17.8739	17.1504	14.7995	13.7139	15.7369	15.9249	18.5589	20.2585	21.9994	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.6712	13.2321	14.6052	14.0835	14.5162	14.0056	14.4461	14.4916	14.0481	14.5684	14.1570	14.6569	(61)	
Total heat required for water heating calculated for each month													
166.1124	145.6836	151.2832	133.2428	128.8524	112.6690	105.8722	119.4044	120.2139	138.2944	149.2136	161.3196	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3896	(H8)
Utilisation factor												0.5131	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.8365	(H14)
Volume ratio Veff/V												0.8079	(H15)
Solar storage volume factor												0.9573	(H16)
Solar input												-876.6189	(H17)
Solar input -28.5974	-40.6637	-69.8912	-94.2994	-110.7603	-118.3095	-115.8214	-103.6637	-81.1615	-56.1123	-33.8232	-23.5154	(63)	
									Solar input (sum of months) = Sum(63)m =		-876.6189	(63)	
Output from w/h													
137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)	
									Total per year (kWh/year) = Sum(64)m =		771.1322	(64)	
Heat gains from water heating, kWh/month													
54.0220	47.3481	49.0967	43.1413	41.6458	36.3070	34.0107	38.5064	38.8121	44.7810	48.4456	52.4296	(65)	

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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	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	148.1343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.3057	44.6811	36.3371	27.5095	20.5637	17.3607	18.7589	24.3835	32.7275	41.5551	48.5009	51.7039	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	328.5195	331.9285	323.3379	305.0496	281.9638	260.2665	245.7713	242.3623	250.9529	269.2413	292.3270	314.0243	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	52.2823	(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)													
	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	-98.7562	(71)
Water heating gains (Table 5)													
	72.6102	70.4585	65.9902	59.9185	55.9756	50.4264	45.7133	51.7559	53.9058	60.1895	67.2855	70.4699	(72)
Total internal gains													
	556.0958	551.7285	530.3257	497.1380	463.1635	432.7140	414.9040	423.1622	442.2466	475.6463	512.7738	540.8585	(73)

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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	
Northeast	3.6300	14.6176	0.4600	0.0000	0.7700	18.7946	(75)
Southwest	4.6800	45.1778	0.4600	0.0000	0.7700	74.8893	(79)
Northwest	2.4700	14.6176	0.4600	0.0000	0.7700	12.7886	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	159.7591	240.8422	357.1980	487.6193	555.5130	616.2529	582.4025	518.3817	423.4578	294.3774	192.6923	133.1539	(83)
Total gains	715.8549	792.5707	887.5237	984.7573	1018.6765	1048.9669	997.3065	941.5439	865.7044	770.0237	705.4661	674.0123	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5399	34.7434	34.6770	34.8084	34.8084	34.8719	34.9339	34.9945	35.0536	34.8719	34.9945	34.8719	
alpha	3.3027	3.3162	3.3118	3.3206	3.3206	3.3248	3.3289	3.3330	3.3369	3.3248	3.3330	3.3248	
util living area													
	0.9556	0.9383	0.8947	0.8059	0.6718	0.4851	0.3607	0.3800	0.6092	0.8278	0.9273	0.9612	(86)
MIT	19.5409	19.7208	20.0797	20.4923	20.7921	20.9479	20.9853	20.9830	20.8875	20.5357	20.0032	19.5157	(87)
Th 2	19.9286	19.9342	19.9324	19.9360	19.9360	19.9377	19.9394	19.9410	19.9426	19.9377	19.9410	19.9377	(88)
util rest of house													
	0.9470	0.9268	0.8750	0.7703	0.6131	0.4046	0.2664	0.2814	0.5288	0.7868	0.9111	0.9535	(89)
MIT 2	18.0323	18.2914	18.7950	19.3573	19.7346	19.9016	19.9332	19.9337	19.8531	19.4309	18.7034	18.0031	(90)
Living area fraction										fLA = Living area / (4) =		0.2505	(91)
MIT	18.4102	18.6495	19.1168	19.6416	19.9995	20.1637	20.1967	20.1965	20.1122	19.7076	19.0290	18.3820	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2602	18.4995	18.9668	19.4916	19.8495	20.0137	20.0467	20.0465	19.9622	19.5576	18.8790	18.2320	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9290	0.9067	0.8532	0.7533	0.6079	0.4106	0.2762	0.2915	0.5304	0.7697	0.8905	0.9367	(94)
Useful gains	665.0609	718.6043	757.2478	741.8302	619.2808	430.6544	275.4155	274.4257	459.1888	592.6501	628.1879	631.3695	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1276.1423	1253.4024	1138.5277	947.0206	696.5985	445.9535	278.2917	277.7924	495.2672	771.7834	1035.0704	1251.8654	(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	454.6446	359.3843	283.6722	147.7371	57.5244	0.0000	0.0000	0.0000	0.0000	133.2752	292.9554	461.6490	(98)
Space heating												2190.8422	(98)
Space heating per m2											(98) / (4) =	27.2764	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2420.8201	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	454.6446	359.3843	283.6722	147.7371	57.5244	0.0000	0.0000	0.0000	0.0000	133.2752	292.9554	461.6490	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	502.3697	397.1097	313.4500	163.2454	63.5629	0.0000	0.0000	0.0000	0.0000	147.2655	323.7076	510.1094	(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	137.5150	105.0198	81.3921	38.9434	18.0921	0.0000	0.0000	15.7407	39.0524	82.1821	115.3904	137.8042	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7361	89.7560	89.7664	89.8132	89.7132	87.3000	87.3000	87.3000	87.3000	89.2521	89.5722	89.7438	(217)
Fuel for water heating, kWh/month	153.2437	117.0059	90.6710	43.3604	20.1666	0.0000	0.0000	18.0306	44.7335	92.0786	128.8239	153.5529	(219)
Water heating fuel used												861.6672	(219)
Annual totals kWh/year													
Space heating fuel - main system												2420.8201	(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)												355.3658	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2393.8759	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2420.8201	10.2300	247.6499	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	861.6672	10.2300	88.1486	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	355.3658	36.7200	130.4903	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			112.5004	(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	2420.8201	0.2160	522.8971	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6672	0.2160	186.1201	(264)
Space and water heating			709.0173	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	355.3658	0.5190	184.4348	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			247.8280 (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	2420.8201	1.2200	2953.4005	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	861.6672	1.2200	1051.2340	(264)
Space and water heating			4004.6345	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	355.3658	3.0700	1090.9729	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1276.5976	(272)
Primary energy kWh/m2/year			15.8939	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	274.07 (P1)
Transmission heat loss coefficient	57.20 (37)
Summer heat loss coefficient	331.27 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.6300	106.0502	0.4600	0.0000	0.9000	159.3744
South West	4.6800	127.3119	0.4600	0.0000	0.9000	246.6693
North West	2.4700	106.0502	0.4600	0.0000	0.9000	108.4448
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						690.0032

	Jun	Jul	Aug	
Solar gains	742	690	612	(P4)
Internal gains	430	412	420	
Total summer gains	1172	1102	1032	(P5)
Summer gain/loss ratio	3.54	3.33	3.12	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 147.9)	0.96	0.96	0.96	
Threshold temperature	19.90	21.59	21.38	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-576.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	3-As-SEMI
Property	36, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	92 A	**DER**	9.16	**TER**	17.39
Environmental	93 A	**% DER<TER**	47.32		
CO_2 Emissions (t/year)	0.54	**DFEE**	43.40	**TFEE**	50.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.84		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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DWELLING AS BUILT

Semi-Detached House, total floor area 94 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.39 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.16 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.4 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.96 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.12 m², No overhang
Windows facing South East: 1.54 m², No overhang
Windows facing South West: 7.82 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.9600	
Infiltration rate			0.3715	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)		0.3436	(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	0.4381	0.4295	0.4209	0.3780	0.3694	0.3264	0.3264	0.3178	0.3436	0.3694	0.3866	0.4037	(22b)
Effective ac	0.5960	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.7883	47.4895	47.1966	45.8209	45.5635	44.3654	44.3654	44.1435	44.8269	45.5635	46.0842	46.6286	(38)
Heat transfer coeff	108.2690	107.9702	107.6773	106.3016	106.0442	104.8460	104.8460	104.6241	105.3075	106.0442	106.5649	107.1092	(39)
Average = Sum(39)m / 12 =												106.3004	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1518	1.1486	1.1455	1.1309	1.1281	1.1154	1.1154	1.1130	1.1203	1.1281	1.1337	1.1395	(40)
HLP (average)												1.1309	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	411.8538	409.5270	394.5029	370.2917	345.6020	322.0051	306.8291	313.2546	325.8427	350.2772	378.2818	399.3869	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	550.3021	650.8247	739.1838	821.7174	873.4613	855.8231	817.4184	765.3264	707.2550	620.8794	545.1069	517.2253	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7179	34.8140	34.9087	35.3605	35.4463	35.8514	35.8514	35.9274	35.6943	35.4463	35.2731	35.0938	
alpha	3.3145	3.3209	3.3272	3.3574	3.3631	3.3901	3.3901	3.3952	3.3796	3.3631	3.3515	3.3396	
util living area													
	0.9864	0.9757	0.9545	0.9065	0.8152	0.6710	0.5259	0.5733	0.7820	0.9311	0.9775	0.9889	(86)
MIT	19.0991	19.3409	19.7120	20.1820	20.5854	20.8531	20.9523	20.9354	20.7370	20.2064	19.5680	19.0584	(87)
Th 2	19.9588	19.9613	19.9638	19.9757	19.9779	19.9883	19.9883	19.9902	19.9843	19.9779	19.9734	19.9687	(88)
util rest of house													
	0.9837	0.9708	0.9449	0.8859	0.7727	0.5947	0.4196	0.4675	0.7183	0.9116	0.9722	0.9866	(89)
MIT 2	17.4193	17.7713	18.3078	18.9810	19.5286	19.8638	19.9611	19.9505	19.7364	19.0290	18.1115	17.3662	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	17.7231	18.0552	18.5617	19.1982	19.7197	20.0427	20.1404	20.1286	19.9174	19.2419	18.3749	17.6723	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5731	17.9052	18.4117	19.0482	19.5697	19.8927	19.9904	19.9786	19.7674	19.0919	18.2249	17.5223	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9567	0.9254	0.8624	0.7529	0.5867	0.4199	0.4662	0.7023	0.8892	0.9586	0.9782	(94)
Useful gains	535.9753	622.6447	684.0517	708.6745	657.6548	502.1206	343.2115	356.7688	496.7318	552.0863	522.5566	505.9615	(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													
	1437.0610	1404.1720	1282.6219	1078.7736	834.5354	554.9195	355.4663	374.4116	596.8167	900.5170	1185.5287	1426.9379	(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													
	670.4078	525.1863	445.3362	266.4714	131.5991	0.0000	0.0000	0.0000	0.0000	259.2324	477.3399	685.2064	(98)
Space heating												3460.7796	(98)
Space heating per m2											(98) / (4) =	36.8168	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3824.0659	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	670.4078	525.1863	445.3362	266.4714	131.5991	0.0000	0.0000	0.0000	0.0000	259.2324	477.3399	685.2064	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	740.7821	580.3164	492.0842	294.4435	145.4134	0.0000	0.0000	0.0000	0.0000	286.4447	527.4474	757.1342	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8227	89.7605	89.6394	89.3764	88.8542	87.3000	87.3000	87.3000	87.3000	89.3288	89.6907	89.8497	(217)
Fuel for water heating, kWh/month													
	193.3004	169.6174	176.3084	155.6253	151.2970	134.5226	126.2819	142.5977	143.6163	161.6152	173.8054	187.6279	(219)
Water heating fuel used												1916.2154	(219)
Annual totals kWh/year													
Space heating fuel - main system												3824.0659	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5010.4966	(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	3824.0659	0.2160	825.9982	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1916.2154	0.2160	413.9025	(264)
Space and water heating			1239.9008	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			861.1425	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1600	(273)

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

DER		9.1600	ZC1
Total Floor Area	TFA	94.0000	
Assumed number of occupants	N	2.6766	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5235	ZC2
CO2 emissions from cooking, equation (L16)		1.9493	ZC3
Total CO2 emissions		26.6329	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.6329	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8187	47.2508	46.8329	43.3936	44.8400	46.8329	47.2508	50.8187	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
								Total per year (kWh/year) = Sum(64)m =				2113.5938	(64)
Heat gains from water heating, kWh/month													
	65.7696	57.8871	60.5649	53.5384	51.7451	45.3971	43.2245	48.4453	48.9886	56.0296	59.6213	64.0963	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	88.4000	86.1415	81.4045	74.3589	69.5498	63.0516	58.0975	65.1147	68.0397	75.3085	82.8073	86.1510	(72)
Total internal gains													
	424.2260	421.9032	406.8408	381.9756	356.6272	332.3736	317.2055	324.2871	337.5375	362.6260	390.6641	411.7631	(73)

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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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southeast	1.5400	36.7938	0.6300	0.7000	0.7700	17.3168	(77)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)

Solar gains	119.4568	208.1980	297.3997	389.5018	455.4507	460.5921	440.5497	390.0593	329.0925	233.4826	143.9410	101.6740	(83)
Total gains	543.6828	630.1012	704.2405	771.4774	812.0779	792.9657	757.7552	714.3464	666.6300	596.1087	534.6051	513.4371	(84)

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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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9983	0.9961	0.9897	0.9675	0.9002	0.7487	0.5760	0.6288	0.8633	0.9787	0.9964	0.9988	(86)
MIT	19.7777	19.9307	20.1732	20.4913	20.7700	20.9408	20.9879	20.9812	20.8678	20.5066	20.0849	19.7540	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9978	0.9947	0.9860	0.9548	0.8606	0.6609	0.4550	0.5071	0.7967	0.9681	0.9949	0.9983	(89)
MIT 2	18.3506	18.5757	18.9301	19.3939	19.7707	19.9728	20.0091	20.0077	19.9003	19.4231	18.8103	18.3231	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.6087	18.8208	19.1549	19.5924	19.9514	20.1479	20.1862	20.1838	20.0753	19.6191	19.0408	18.5819	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6087	18.8208	19.1549	19.5924	19.9514	20.1479	20.1862	20.1838	20.0753	19.6191	19.0408	18.5819	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9925	0.9816	0.9480	0.8582	0.6739	0.4769	0.5289	0.8019	0.9624	0.9927	0.9974	(94)
Useful gains	541.8229	625.3520	691.3117	731.3922	696.8991	534.3831	361.3714	377.8468	534.5436	573.7094	530.7186	512.1164	(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													
	1507.7178	1462.6384	1325.8874	1105.3995	850.9052	565.3902	365.4683	384.7571	611.7350	930.0661	1237.6482	1498.5735	(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													
	718.6258	562.6565	472.1243	269.2852	114.5806	0.0000	0.0000	0.0000	0.0000	265.1294	508.9893	733.9241	(98)
Space heating												3645.3152	(98)
Space heating per m2											(98) / (4) =	38.7799	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3902.9071	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	718.6258	562.6565	472.1243	269.2852	114.5806	0.0000	0.0000	0.0000	0.0000	265.1294	508.9893	733.9241	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	769.4066	602.4159	505.4864	288.3139	122.6773	0.0000	0.0000	0.0000	0.0000	283.8644	544.9565	785.7860	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8958	87.6659	87.1970	86.1647	84.1211	80.3000	80.3000	80.3000	80.3000	86.0093	87.3944	87.9801	(217)
Fuel for water heating, kWh/month													
	239.4280	211.6181	223.3555	200.4785	198.8139	183.4366	175.7462	195.9159	198.0796	210.5809	219.1767	233.4787	(219)
Water heating fuel used												2490.1088	(219)
Annual totals kWh/year													
Space heating fuel - main system												3902.9071	(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)												413.7723	(232)
Total delivered energy for all uses												6881.7882	(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	3902.9071	0.2160	843.0279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2490.1088	0.2160	537.8635	(264)
Space and water heating			1380.8914	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Total CO2, kg/m2/year			1634.5643	(272)
Emissions per m2 for space and water heating			14.6903	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2846	(272b)
Emissions per m2 for pumps and fans			0.4141	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6903 * 1.00) + 2.2846 + 0.4141, rounded to 2 d.p.			17.3900	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		4.9600	
Infiltration rate		0.3715	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3436	(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	0.4381	0.4295	0.4209	0.3780	0.3694	0.3264	0.3264	0.3178	0.3436	0.3694	0.3866	0.4037	(22b)
Effective ac	0.5960	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.7883	47.4895	47.1966	45.8209	45.5635	44.3654	44.3654	44.1435	44.8269	45.5635	46.0842	46.6286	(38)
Heat transfer coeff	108.2690	107.9702	107.6773	106.3016	106.0442	104.8460	104.8460	104.6241	105.3075	106.0442	106.5649	107.1092	(39)
Average = Sum(39)m / 12 =												106.3004	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1518	1.1486	1.1455	1.1309	1.1281	1.1154	1.1154	1.1130	1.1203	1.1281	1.1337	1.1395	(40)
HLP (average)												1.1309	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	516.8271	618.1688	708.2293	793.0795	846.3283	830.8067	794.1978	739.8015	680.9088	592.1359	513.6604	484.5660	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7179	34.8140	34.9087	35.3605	35.4463	35.8514	35.8514	35.9274	35.6943	35.4463	35.2731	35.0938	
alpha	3.3145	3.3209	3.3272	3.3574	3.3631	3.3901	3.3901	3.3952	3.3796	3.3631	3.3515	3.3396	
util living area													
	0.9887	0.9790	0.9593	0.9139	0.8259	0.6839	0.5383	0.5883	0.7961	0.9388	0.9810	0.9908	(86)
MIT	19.0512	19.2961	19.6727	20.1516	20.5656	20.8440	20.9488	20.9301	20.7203	20.1728	19.5243	19.0111	(87)
Th 2	19.9588	19.9613	19.9638	19.9757	19.9779	19.9883	19.9883	19.9902	19.9843	19.9779	19.9734	19.9687	(88)
util rest of house													
	0.9864	0.9746	0.9506	0.8945	0.7847	0.6079	0.4307	0.4814	0.7340	0.9210	0.9764	0.9889	(89)
MIT 2	18.1775	18.4220	18.7952	19.2686	19.6547	19.8974	19.9682	19.9606	19.8027	19.2988	18.6594	18.1450	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.3355	18.5801	18.9539	19.4283	19.8195	20.0685	20.1455	20.1359	19.9686	19.4569	18.8158	18.3016	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3355	18.5801	18.9539	19.4283	19.8195	20.0685	20.1455	20.1359	19.9686	19.4569	18.8158	18.3016	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9813	0.9670	0.9398	0.8820	0.7774	0.6144	0.4484	0.4979	0.7329	0.9096	0.9694	0.9846	(94)
Useful gains	507.1778	597.7713	665.5895	699.5134	657.9292	510.4849	356.0985	368.3757	499.0656	538.6054	497.9220	477.1259	(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													
	1519.6132	1477.0399	1341.0021	1119.1757	861.0212	573.3557	371.7368	390.8683	618.0099	939.2188	1248.4909	1510.4157	(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													
	753.2519	590.8685	502.5070	302.1568	151.1004	0.0000	0.0000	0.0000	0.0000	298.0564	540.4096	768.7676	(98)
Space heating												3907.1183	(98)
Space heating per m2											(98) / (4) =	41.5651	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	985.5527	775.8606	795.1435	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8040	0.8669	0.8414	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	792.3375	672.5856	669.0142	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1073.2673	1028.3620	966.7569	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	202.2695	264.6977	221.5206	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												688.4878	(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	50.5674	66.1744	55.3802	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												172.1220	(107)
Space cooling per m2												1.8311	(108)
Energy for space heating												41.5651	(99)
Energy for space cooling												1.8311	(108)
Total												43.3962	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.4	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southeast	1.5400	36.7938	0.6300	0.7000	0.7700	17.3168	(77)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)

Solar gains	119.4568	208.1980	297.3997	389.5018	455.4507	460.5921	440.5497	390.0593	329.0925	233.4826	143.9410	101.6740	(83)
Total gains	497.8356	585.0690	660.9481	731.1557	773.9198	757.5808	724.1583	677.7890	628.5889	555.0163	490.7763	468.4016	(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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9989	0.9972	0.9922	0.9737	0.9145	0.7716	0.5994	0.6567	0.8847	0.9842	0.9976	0.9992	(86)
MIT	19.7320	19.8863	20.1318	20.4565	20.7465	20.9316	20.9855	20.9771	20.8482	20.4692	20.0414	19.7089	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9985	0.9962	0.9893	0.9631	0.8785	0.6852	0.4751	0.5324	0.8235	0.9760	0.9965	0.9989	(89)
MIT 2	18.8231	18.9791	19.2253	19.5538	19.8253	19.9808	20.0099	20.0089	19.9215	19.5715	19.1442	18.8082	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.9875	19.1432	19.3892	19.7171	19.9919	20.1527	20.1863	20.1840	20.0891	19.7338	19.3065	18.9711	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9875	19.1432	19.3892	19.7171	19.9919	20.1527	20.1863	20.1840	20.0891	19.7338	19.3065	18.9711	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9951	0.9870	0.9593	0.8780	0.6986	0.4978	0.5550	0.8294	0.9730	0.9955	0.9985	(94)
Useful gains	496.8310	582.2117	652.3501	701.3616	679.4924	529.2258	360.4909	376.1605	521.3463	540.0429	488.5842	467.7116	(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													
	1547.6337	1496.5118	1350.4389	1118.2935	855.0775	565.8824	365.4877	384.7785	613.1458	941.8994	1265.1809	1539.1249	(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													
	781.7972	614.4097	519.3780	300.1910	130.6354	0.0000	0.0000	0.0000	0.0000	298.9813	559.1497	797.1315	(98)
Space heating												4001.6737	(98)
Space heating per m2											(98) / (4) =	42.5710	(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	957.9624	754.1406	772.8182	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8531	0.9192	0.8953	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	817.2100	693.1896	691.8941	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.6786	946.4976	894.2749	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	122.7374	188.4612	150.5712	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												461.7698	(104)

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	30.6844	47.1153	37.6428	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												115.4425 (107)
Space cooling per m2												1.2281 (108)
Energy for space heating												42.5710 (99)
Energy for space cooling												1.2281 (108)
Total												43.7991 (109)
Target Fabric Energy Efficiency (TFEE)												50.4 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.9600	
Infiltration rate			0.3715	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3007	0.2921	0.3178	0.3007	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5427	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (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	45.3121	44.5932	44.8269	44.3654	44.3654	44.1435	43.9275	43.7175	43.5133	44.1435	43.7175	44.1435	(38)
Heat transfer coeff	105.7927	105.0738	105.3075	104.8460	104.8460	104.6241	104.4082	104.1981	103.9940	104.6241	104.1981	104.6241	(39)
Average = Sum(39)m / 12 =												104.7114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1255	1.1178	1.1203	1.1154	1.1154	1.1130	1.1107	1.1085	1.1063	1.1130	1.1085	1.1130	(40)
HLP (average)												1.1140	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m
23.9232 20.9234 21.5911 18.8236 18.0617 15.5859 14.4426 16.5731 16.7711 19.5451 21.3350 23.1684 (46)
Water storage loss:
Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 14.1393 12.7601 14.1011 13.6014 14.0221 13.5322 13.9599 14.0003 13.5699 14.0684 13.6542 14.1273 (61)
Total heat required for water heating calculated for each month
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (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
173.6276 152.2495 158.0417 139.0923 134.4337 117.4382 110.2441 124.4878 125.3770 144.3688 155.8872 168.5831 (64)
Total per year (kWh/year) = Sum(64)m = 1703.8311 (64)
RHI water heating demand 1704 (64)
Heat gains from water heating, kWh/month
56.5647 49.5703 51.3855 45.1261 43.5424 37.9318 35.5045 40.2372 40.5683 46.8420 50.7060 54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southeast	1.5400	45.1778	0.4600	0.0000	0.7700	24.6431	(77)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	171.1102	254.2677	367.8458	488.1156	545.3413	600.2941	569.1876	514.3050	431.0642	308.0873	205.5918	143.1222	(83)
Total gains	783.5136	861.6734	951.2267	1034.3663	1053.5269	1074.6346	1023.9775	978.1913	916.5394	830.9158	769.8005	738.6839	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.5306	35.7736	35.6943	35.8514	35.8514	35.9274	36.0017	36.0743	36.1451	35.9274	36.0743	35.9274	
alpha	3.3687	3.3849	3.3796	3.3901	3.3901	3.3952	3.4001	3.4050	3.4097	3.3952	3.4050	3.3952	
util living area													
	0.9591	0.9437	0.9054	0.8274	0.7039	0.5188	0.3871	0.4030	0.6308	0.8395	0.9326	0.9643	(86)
MIT	19.5597	19.7315	20.0710	20.4691	20.7729	20.9410	20.9835	20.9815	20.8829	20.5341	20.0161	19.5396	(87)
Th 2	19.9801	19.9863	19.9843	19.9883	19.9883	19.9902	19.9921	19.9939	19.9957	19.9902	19.9939	19.9902	(88)
util rest of house													
	0.9514	0.9334	0.8878	0.7952	0.6486	0.4387	0.2916	0.3044	0.5536	0.8018	0.9180	0.9574	(89)
MIT 2	18.0963	18.3451	18.8238	19.3724	19.7620	19.9474	19.9846	19.9854	19.8992	19.4730	18.7613	18.0750	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3610	18.5959	19.0494	19.5708	19.9448	20.1271	20.1652	20.1655	20.0771	19.6649	18.9883	18.3398	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2110	18.4459	18.8994	19.4208	19.7948	19.9771	20.0152	20.0155	19.9271	19.5149	18.8383	18.1898	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9333	0.9128	0.8646	0.7744	0.6370	0.4376	0.2939	0.3065	0.5479	0.7807	0.8963	0.9405	(94)
Useful gains	731.2494	786.5695	822.4319	800.9755	671.0751	470.2988	300.9018	299.8644	502.1999	648.7198	689.9494	694.7360	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1408.2039	1381.2862	1253.0940	1040.1529	764.8326	489.3387	304.3759	303.7946	543.5893	849.0182	1139.7458	1379.9767	(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													
	503.6542	399.6496	320.4126	172.2077	69.7556	0.0000	0.0000	0.0000	0.0000	149.0221	323.8534	509.8191	(98)
Space heating												2448.3742	(98)
RHI space heating demand												2448	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				4.9600	
Infiltration rate				0.3715	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3436	(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	0.4381	0.4295	0.4209	0.3780	0.3694	0.3264	0.3264	0.3178	0.3436	0.3694	0.3866	0.4037	(22b)
Effective ac	0.5960	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.7883	47.4895	47.1966	45.8209	45.5635	44.3654	44.3654	44.1435	44.8269	45.5635	46.0842	46.6286	(38)
Heat transfer coeff	108.2690	107.9702	107.6773	106.3016	106.0442	104.8460	104.8460	104.6241	105.3075	106.0442	106.5649	107.1092	(39)
Average = Sum(39)m / 12 =												106.3004	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1518	1.1486	1.1455	1.1309	1.1281	1.1154	1.1154	1.1130	1.1203	1.1281	1.1337	1.1395	(40)
HLP (average)												1.1309	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384	(83)
Total gains	750.8517	848.7034	928.0618	997.6764	1036.0449	1008.1586	965.3792	915.9581	866.8875	793.4307	731.0338	713.4002	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7179	34.8140	34.9087	35.3605	35.4463	35.8514	35.8514	35.9274	35.6943	35.4463	35.2731	35.0938	
alpha	3.3145	3.3209	3.3272	3.3574	3.3631	3.3901	3.3901	3.3952	3.3796	3.3631	3.3515	3.3396	
util living area													
	0.9675	0.9504	0.9197	0.8572	0.7515	0.5983	0.4566	0.4956	0.6995	0.8784	0.9502	0.9720	(86)
MIT	19.3749	19.5990	19.9348	20.3486	20.6860	20.8971	20.9689	20.9585	20.8177	20.3862	19.8123	19.3327	(87)
Th 2	19.9588	19.9613	19.9638	19.9757	19.9779	19.9883	19.9883	19.9902	19.9843	19.9779	19.9734	19.9687	(88)
util rest of house													
	0.9614	0.9413	0.9046	0.8297	0.7033	0.5228	0.3600	0.3981	0.6297	0.8491	0.9394	0.9667	(89)
MIT 2	17.8166	18.1393	18.6187	19.2020	19.6475	19.9042	19.9712	19.9658	19.8205	19.2674	18.4584	17.7623	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.0984	18.4033	18.8567	19.4094	19.8353	20.0838	20.1517	20.1454	20.0009	19.4697	18.7032	18.0463	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9484	18.2533	18.7067	19.2594	19.6853	19.9338	20.0017	19.9954	19.8509	19.3197	18.5532	17.8963	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9212	0.8814	0.8070	0.6879	0.5185	0.3614	0.3986	0.6195	0.8259	0.9194	0.9516	(94)
Useful gains	709.4626	781.8575	817.9549	805.0982	712.6780	522.7025	348.8630	365.1393	537.0471	655.2953	672.0891	678.8960	(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													
	1477.6990	1441.7565	1314.3829	1101.2211	846.7991	559.2226	356.6510	376.1616	605.6110	924.6782	1220.5099	1467.0006	(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													
	571.5679	443.4522	369.3424	213.2085	99.7861	0.0000	0.0000	0.0000	0.0000	200.4209	394.8629	586.3498	(98)
Space heating												2878.9906	(98)
Space heating per m2											(98) / (4) =	30.6276	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3181.2051	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	571.5679	443.4522	369.3424	213.2085	99.7861	0.0000	0.0000	0.0000	0.0000	200.4209	394.8629	586.3498	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	631.5667	490.0024	408.1132	235.5895	110.2609	0.0000	0.0000	0.0000	0.0000	221.4595	436.3126	647.9003	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7336	89.6600	89.5167	89.2090	88.6352	87.3000	87.3000	87.3000	87.3000	89.1320	89.5707	89.7652	(217)
Fuel for water heating, kWh/month													
	193.4923	169.8076	176.5500	155.9174	151.6707	134.5226	126.2819	142.5977	143.6163	161.9719	174.0382	187.8045	(219)
Water heating fuel used												1918.2710	(219)
Annual totals kWh/year													
Space heating fuel - main system												3181.2051	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4369.6913	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3181.2051	3.4800	110.7059	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1918.2710	3.4800	66.7558	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			201.2032	(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] =	0.6080	(257)
SAP value		91.5191	
SAP rating (Section 12)		92	(258)
SAP band		A	

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	3181.2051	0.2160	687.1403	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1918.2710	0.2160	414.3465	(264)
Space and water heating			1101.4868	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			722.7286	(272)
CO2 emissions per m2			7.6900	(273)
EI value			93.0327	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8870 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8870 = 0.2435, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.9600	
Infiltration rate			0.3715	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3007	0.2921	0.3178	0.3007	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5427	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(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	45.3121	44.5932	44.8269	44.3654	44.3654	44.1435	43.9275	43.7175	43.5133	44.1435	43.7175	44.1435	(38)
Heat transfer coeff	105.7927	105.0738	105.3075	104.8460	104.8460	104.6241	104.4082	104.1981	103.9940	104.6241	104.1981	104.6241	(39)
Average = Sum(39)m / 12 =												104.7114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1255	1.1178	1.1203	1.1154	1.1154	1.1130	1.1107	1.1085	1.1063	1.1130	1.1085	1.1130	(40)
HLP (average)												1.1140	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southeast	1.5400	45.1778	0.4600	0.0000	0.7700	24.6431	(77)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	171.1102	254.2677	367.8458	488.1156	545.3413	600.2941	569.1876	514.3050	431.0642	308.0873	205.5918	143.1222	(83)
Total gains	783.5136	861.6734	951.2267	1034.3663	1053.5269	1074.6346	1023.9775	978.1913	916.5394	830.9158	769.8005	738.6839	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.5306	35.7736	35.6943	35.8514	35.8514	35.9274	36.0017	36.0743	36.1451	35.9274	36.0743	35.9274	
alpha	3.3687	3.3849	3.3796	3.3901	3.3901	3.3952	3.4001	3.4050	3.4097	3.3952	3.4050	3.3952	
util living area													
	0.9591	0.9437	0.9054	0.8274	0.7039	0.5188	0.3871	0.4030	0.6308	0.8395	0.9326	0.9643	(86)
MIT	19.5597	19.7315	20.0710	20.4691	20.7729	20.9410	20.9835	20.9815	20.8829	20.5341	20.0161	19.5396	(87)
Th 2	19.9801	19.9863	19.9843	19.9883	19.9883	19.9902	19.9921	19.9939	19.9957	19.9902	19.9939	19.9902	(88)
util rest of house													
	0.9514	0.9334	0.8878	0.7952	0.6486	0.4387	0.2916	0.3044	0.5536	0.8018	0.9180	0.9574	(89)
MIT 2	18.0963	18.3451	18.8238	19.3724	19.7620	19.9474	19.9846	19.9854	19.8992	19.4730	18.7613	18.0750	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3610	18.5959	19.0494	19.5708	19.9448	20.1271	20.1652	20.1655	20.0771	19.6649	18.9883	18.3398	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2110	18.4459	18.8994	19.4208	19.7948	19.9771	20.0152	20.0155	19.9271	19.5149	18.8383	18.1898	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9333	0.9128	0.8646	0.7744	0.6370	0.4376	0.2939	0.3065	0.5479	0.7807	0.8963	0.9405	(94)
Useful gains	731.2494	786.5695	822.4319	800.9755	671.0751	470.2988	300.9018	299.8644	502.1999	648.7198	689.9494	694.7360	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1408.2039	1381.2862	1253.0940	1040.1529	764.8326	489.3387	304.3759	303.7946	543.5893	849.0182	1139.7458	1379.9767	(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													
	503.6542	399.6496	320.4126	172.2077	69.7556	0.0000	0.0000	0.0000	0.0000	149.0221	323.8534	509.8191	(98)
Space heating												2448.3742	(98)
Space heating per m2											(98) / (4) =	26.0465	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2705.3859	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	503.6542	399.6496	320.4126	172.2077	69.7556	0.0000	0.0000	0.0000	0.0000	149.0221	323.8534	509.8191	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	556.5240	441.6018	354.0470	190.2847	77.0780	0.0000	0.0000	0.0000	0.0000	164.6653	357.8490	563.3361	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6575	89.5940	89.4173	89.0417	88.3674	87.3000	87.3000	87.3000	87.3000	88.8966	89.4348	89.6831	(217)
Fuel for water heating, kWh/month													
	193.6566	169.9327	176.7461	156.2103	152.1304	134.5226	126.2819	142.5977	143.6163	162.4009	174.3027	187.9765	(219)
Water heating fuel used												1920.3746	(219)
Annual totals kWh/year													
Space heating fuel - main system												2705.3859	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3745.5557	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2705.3859	10.2300	276.7610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1920.3746	10.2300	196.4543	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			253.0041	(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	2705.3859	0.2160	584.3634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.3746	0.2160	414.8009	(264)
Space and water heating			999.1643	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			542.3380	(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	2705.3859	1.2200	3300.5708	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.3746	1.2200	2342.8570	(264)
Space and water heating			5643.4278	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2941.1991	(272)
Primary energy kWh/m2/year			31.2894	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 85	-191 kg (35.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.04 kg/m²	A 93	A 95
Total Savings	£85	2.04 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£179	£198	-£18
Mains gas	£576	£473	£103
Space heating	£407	£407	£0
Water heating	£196	£112	£85
Lighting	£152	£152	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£252	£168	£85
Total cost of uses	£252	£168	£85
Delivered energy	40 kWh/m²	30 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	31 kWh/m²	20 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.9600	
Infiltration rate			0.3715	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3436	(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	0.4381	0.4295	0.4209	0.3780	0.3694	0.3264	0.3264	0.3178	0.3436	0.3694	0.3866	0.4037	(22b)
Effective ac	0.5960	0.5922	0.5886	0.5714	0.5682	0.5533	0.5533	0.5505	0.5590	0.5682	0.5747	0.5815	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.7883	47.4895	47.1966	45.8209	45.5635	44.3654	44.3654	44.1435	44.8269	45.5635	46.0842	46.6286	(38)
Heat transfer coeff	108.2690	107.9702	107.6773	106.3016	106.0442	104.8460	104.8460	104.6241	105.3075	106.0442	106.5649	107.1092	(39)
Average = Sum(39)m / 12 =												106.3004	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1518	1.1486	1.1455	1.1309	1.1281	1.1154	1.1154	1.1130	1.1203	1.1281	1.1337	1.1395	(40)
HLP (average)												1.1309	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)

Distribution loss (46)m = 0.15 x (45)m

	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273 (61)

Total heat required for water heating calculated for each month

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (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	1.1790 (H8)
Utilisation factor	0.5718 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	97.7695 (H14)
Volume ratio Veff/V	0.7671 (H15)
Solar storage volume factor	0.9470 (H16)
Solar input	-863.5142 (H17)

Solar input

	-25.0402	-41.7849	-71.1644	-95.3744	-117.8270	-115.8427	-114.3118	-99.8748	-78.2220	-53.4164	-29.7013	-20.9544 (63)

Solar input (sum of months) = Sum(63)m = -863.5142 (63)

Output from w/h

	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288 (64)

Total per year (kWh/year) = Sum(64)m = 844.3846 (64)

Heat gains from water heating, kWh/month

	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363 (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)

	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644 (71)

Water heating gains (Table 5)

	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747 (72)

Total internal gains

	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618 (73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southeast	1.5400	36.7938	0.4600	0.0000	0.7700	20.0699	(77)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	138.4483	241.2977	344.6809	451.4257	527.8592	533.8180	510.5892	452.0718	381.4123	270.6022	166.8251	117.8384 (83)
Total gains	750.8517	848.7034	928.0618	997.6764	1036.0449	1008.1586	965.3792	915.9581	866.8875	793.4307	731.0338	713.4002 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7179	34.8140	34.9087	35.3605	35.4463	35.8514	35.8514	35.9274	35.6943	35.4463	35.2731	35.0938	
alpha	3.3145	3.3209	3.3272	3.3574	3.3631	3.3901	3.3901	3.3952	3.3796	3.3631	3.3515	3.3396	
util living area	0.9675	0.9504	0.9197	0.8572	0.7515	0.5983	0.4566	0.4956	0.6995	0.8784	0.9502	0.9720	(86)
MIT	19.3749	19.5990	19.9348	20.3486	20.6860	20.8971	20.9689	20.9585	20.8177	20.3862	19.8123	19.3327	(87)
Th 2	19.9588	19.9613	19.9638	19.9757	19.9779	19.9883	19.9883	19.9902	19.9843	19.9779	19.9734	19.9687	(88)
util rest of house	0.9614	0.9413	0.9046	0.8297	0.7033	0.5228	0.3600	0.3981	0.6297	0.8491	0.9394	0.9667	(89)
MIT 2	17.8166	18.1393	18.6187	19.2020	19.6475	19.9042	19.9712	19.9658	19.8205	19.2674	18.4584	17.7623	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.0984	18.4033	18.8567	19.4094	19.8353	20.0838	20.1517	20.1454	20.0009	19.4697	18.7032	18.0463	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9484	18.2533	18.7067	19.2594	19.6853	19.9338	20.0017	19.9954	19.8509	19.3197	18.5532	17.8963	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9212	0.8814	0.8070	0.6879	0.5185	0.3614	0.3986	0.6195	0.8259	0.9194	0.9516	(94)
Useful gains	709.4626	781.8575	817.9549	805.0982	712.6780	522.7025	348.8630	365.1393	537.0471	655.2953	672.0891	678.8960	(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	1477.6990	1441.7565	1314.3829	1101.2211	846.7991	559.2226	356.6510	376.1616	605.6110	924.6782	1220.5099	1467.0006	(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	571.5679	443.4522	369.3424	213.2085	99.7861	0.0000	0.0000	0.0000	0.0000	200.4209	394.8629	586.3498	(98)
Space heating												2878.9906	(98)
Space heating per m2											(98) / (4) =	30.6276	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3181.2051	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	571.5679	443.4522	369.3424	213.2085	99.7861	0.0000	0.0000	0.0000	0.0000	200.4209	394.8629	586.3498	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	631.5667	490.0024	408.1132	235.5895	110.2609	0.0000	0.0000	0.0000	0.0000	221.4595	436.3126	647.9003	(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													
	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8207	89.8433	89.8727	89.9390	90.0292	87.3000	87.3000	87.3000	87.3000	89.4762	89.7037	89.8377	(217)
Fuel for water heating, kWh/month													
	165.4267	122.9526	96.6671	48.6084	18.4459	1.8276	0.0000	28.1936	54.0149	101.6498	140.6697	164.3284	(219)
Water heating fuel used												942.7848	(219)
Annual totals kWh/year													
Space heating fuel - main system												3181.2051	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3444.2052	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3181.2051	3.4800	110.7059	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	942.7848	3.4800	32.8089	(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	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			173.8512	(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] =	0.5253	(257)
SAP value	92.6720	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3181.2051	0.2160	687.1403	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	942.7848	0.2160	203.6415	(264)
Space and water heating			890.7818	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			537.9735	(272)
CO2 emissions per m2			5.7200	(273)
EI value			94.8138	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.9600	
Infiltration rate			0.3715	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3436	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3608	0.3350	0.3436	0.3264	0.3264	0.3178	0.3092	0.3007	0.2921	0.3178	0.3007	0.3178	(22b)
Effective ac	0.5651	0.5561	0.5590	0.5533	0.5533	0.5505	0.5478	0.5452	0.5427	0.5505	0.5452	0.5505	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (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	45.3121	44.5932	44.8269	44.3654	44.3654	44.1435	43.9275	43.7175	43.5133	44.1435	43.7175	44.1435	(38)
Heat transfer coeff	105.7927	105.0738	105.3075	104.8460	104.8460	104.6241	104.4082	104.1981	103.9940	104.6241	104.1981	104.6241	(39)
Average = Sum(39)m / 12 =												104.7114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1255	1.1178	1.1203	1.1154	1.1154	1.1130	1.1107	1.1085	1.1063	1.1130	1.1085	1.1130	(40)
HLP (average)												1.1140	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3194	(H8)
Utilisation factor												0.5313	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												97.7695	(H14)
Volume ratio Veff/V												0.7671	(H15)
Solar storage volume factor												0.9470	(H16)
Solar input												-898.0119	(H17)
Solar input	-29.2953	-41.6561	-71.5968	-96.6006	-113.4633	-121.1967	-118.6479	-106.1935	-83.1422	-57.4816	-34.6486	-24.0893	(63)
										Solar input (sum of months) = Sum(63)m =		-898.0119	(63)
Output from w/h													
	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
										Total per year (kWh/year) = Sum(64)m =		817.9815	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southeast	1.5400	45.1778	0.4600	0.0000	0.7700	24.6431	(77)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	171.1102	254.2677	367.8458	488.1156	545.3413	600.2941	569.1876	514.3050	431.0642	308.0873	205.5918	143.1222	(83)
Total gains	783.5136	861.6734	951.2267	1034.3663	1053.5269	1074.6346	1023.9775	978.1913	916.5394	830.9158	769.8005	738.6839	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.5306	35.7736	35.6943	35.8514	35.8514	35.9274	36.0017	36.0743	36.1451	35.9274	36.0743	35.9274	
alpha	3.3687	3.3849	3.3796	3.3901	3.3901	3.3952	3.4001	3.4050	3.4097	3.3952	3.4050	3.3952	
util living area													
	0.9591	0.9437	0.9054	0.8274	0.7039	0.5188	0.3871	0.4030	0.6308	0.8395	0.9326	0.9643	(86)
MIT	19.5597	19.7315	20.0710	20.4691	20.7729	20.9410	20.9835	20.9815	20.8829	20.5341	20.0161	19.5396	(87)
Th 2	19.9801	19.9863	19.9843	19.9883	19.9883	19.9902	19.9921	19.9939	19.9957	19.9902	19.9939	19.9902	(88)
util rest of house													
	0.9514	0.9334	0.8878	0.7952	0.6486	0.4387	0.2916	0.3044	0.5536	0.8018	0.9180	0.9574	(89)
MIT 2	18.0963	18.3451	18.8238	19.3724	19.7620	19.9474	19.9846	19.9854	19.8992	19.4730	18.7613	18.0750	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.3610	18.5959	19.0494	19.5708	19.9448	20.1271	20.1652	20.1655	20.0771	19.6649	18.9883	18.3398	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.2110	18.4459	18.8994	19.4208	19.7948	19.9771	20.0152	20.0155	19.9271	19.5149	18.8383	18.1898	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9333	0.9128	0.8646	0.7744	0.6370	0.4376	0.2939	0.3065	0.5479	0.7807	0.8963	0.9405	(94)
Useful gains	731.2494	786.5695	822.4319	800.9755	671.0751	470.2988	300.9018	299.8644	502.1999	648.7198	689.9494	694.7360	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1408.2039	1381.2862	1253.0940	1040.1529	764.8326	489.3387	304.3759	303.7946	543.5893	849.0182	1139.7458	1379.9767	(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	503.6542	399.6496	320.4126	172.2077	69.7556	0.0000	0.0000	0.0000	0.0000	149.0221	323.8534	509.8191	(98)
Space heating												2448.3742	(98)
Space heating per m2											(98) / (4) =	26.0465	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2705.3859	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	503.6542	399.6496	320.4126	172.2077	69.7556	0.0000	0.0000	0.0000	0.0000	149.0221	323.8534	509.8191	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	556.5240	441.6018	354.0470	190.2847	77.0780	0.0000	0.0000	0.0000	0.0000	164.6653	357.8490	563.3361	(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	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7671	89.7867	89.8006	89.8482	89.7397	87.3000	87.3000	87.3000	87.3000	89.2945	89.6053	89.7733	(217)
Fuel for water heating, kWh/month	160.7853	123.1736	96.2632	47.2927	23.3681	0.0000	0.0000	20.9557	48.3790	97.3041	135.3029	160.9541	(219)
Water heating fuel used												913.7786	(219)

Annual totals kWh/year		
Space heating fuel - main system	2705.3859	(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)	413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771	-1368.9771	(233)
Total delivered energy for all uses	2788.9597	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2705.3859	10.2300	276.7610	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	913.7786	10.2300	93.4795	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			168.3893	(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	2705.3859	0.2160	584.3634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.7786	0.2160	197.3762	(264)
Space and water heating			781.7395	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			350.8632	(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	2705.3859	1.2200	3300.5708	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.7786	1.2200	1114.8098	(264)
Space and water heating			4415.3807	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1866.6519	(272)
Primary energy kWh/m2/year			19.8580	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	144.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	320.75	(P1)
Transmission heat loss coefficient	60.48	(37)
Summer heat loss coefficient	381.23	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.1200	106.0502	0.4600	0.0000	0.9000	180.8877
South East	1.5400	127.3119	0.4600	0.0000	0.9000	81.1689
South West	4.4900	127.3119	0.4600	0.0000	0.9000	236.6549
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						674.2263

	Jun	Jul	Aug	
Solar gains	723	674	607	(P4)
Internal gains	471	452	461	
Total summer gains	1194	1126	1068	(P5)
Summer gain/loss ratio	3.13	2.95	2.80	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 144.0)	0.99	0.99	0.99	
Threshold temperature	19.52	21.25	21.09	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-577.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	3-OP-SEMI
Property	38, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	91 B	**DER**	9.26	**TER**	17.55
Environmental	93 A	**% DER<TER**	47.25		
CO_2 Emissions (t/year)	0.55	**DFEE**	43.82	**TFEE**	51.20
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.41		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Semi-Detached House, total floor area 94 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.55 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.26 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²/yrOK
---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.71 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage No cylinder
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK
---
8 Mechanical ventilation
Not applicable
---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.12 m², No overhang
Windows facing South West: 7.82 m², No overhang
Windows facing North West: 1.54 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None
---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3590	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3320	(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	0.4234	0.4150	0.4067	0.3652	0.3569	0.3154	0.3154	0.3071	0.3320	0.3569	0.3735	0.3901	(22b)
Effective ac	0.5896	0.5861	0.5827	0.5667	0.5637	0.5498	0.5498	0.5472	0.5551	0.5637	0.5698	0.5761	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.2791	47.0001	46.7266	45.4419	45.2016	44.0827	44.0827	43.8755	44.5137	45.2016	45.6878	46.1961	(38)
Heat transfer coeff	107.7598	107.4808	107.2072	105.9226	105.6822	104.5634	104.5634	104.3562	104.9943	105.6822	106.1685	106.6768	(39)
Average = Sum(39)m / 12 =												105.9214	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1464	1.1434	1.1405	1.1268	1.1243	1.1124	1.1124	1.1102	1.1170	1.1243	1.1295	1.1349	(40)
HLP (average)												1.1268	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
									Total per year (kWh/year) = Sum(64)m =			1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	411.8538	409.5270	394.5029	370.2917	345.6020	322.0051	306.8291	313.2546	325.8427	350.2772	378.2818	399.3869	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	536.3867	629.1659	714.9793	800.8283	858.3711	844.4961	804.9773	748.0004	684.1102	598.4059	528.8118	505.0757	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8820	34.9725	35.0618	35.4870	35.5677	35.9483	35.9483	36.0197	35.8007	35.5677	35.4048	35.2361	
alpha	3.3255	3.3315	3.3375	3.3658	3.3712	3.3966	3.3966	3.4013	3.3867	3.3712	3.3603	3.3491	
util living area													
	0.9874	0.9779	0.9581	0.9116	0.8204	0.6759	0.5315	0.5825	0.7936	0.9369	0.9794	0.9896	(86)
MIT	19.0892	19.3206	19.6897	20.1655	20.5782	20.8505	20.9510	20.9326	20.7246	20.1849	19.5521	19.0493	(87)
Th 2	19.9631	19.9655	19.9679	19.9790	19.9811	19.9907	19.9907	19.9925	19.9870	19.9811	19.9769	19.9725	(88)
util rest of house													
	0.9848	0.9733	0.9492	0.8918	0.7786	0.5998	0.4248	0.4762	0.7314	0.9188	0.9744	0.9875	(89)
MIT 2	17.4076	17.7448	18.2789	18.9613	19.5225	19.8636	19.9627	19.9508	19.7254	19.0019	18.0908	17.3554	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	17.7117	18.0298	18.5340	19.1791	19.7135	20.0421	20.1415	20.1284	19.9061	19.2159	18.3551	17.6617	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5617	17.8798	18.3840	19.0291	19.5635	19.8921	19.9915	19.9784	19.7561	19.0659	18.2051	17.5117	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9756	0.9601	0.9305	0.8686	0.7586	0.5916	0.4249	0.4745	0.7147	0.8969	0.9616	0.9796	(94)
Useful gains	523.3194	604.0343	665.2971	695.5965	651.1511	499.5903	342.0260	354.9510	488.9274	536.7001	508.4845	494.7535	(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													
	1429.0806	1395.0807	1274.0557	1072.9012	831.0279	553.3601	354.6238	373.4259	593.8628	894.6919	1179.0104	1420.0535	(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													
	673.8863	531.5832	452.9164	271.6594	133.8283	0.0000	0.0000	0.0000	0.0000	266.3459	482.7787	688.4232	(98)
Space heating												3501.4214	(98)
Space heating per m2											(98) / (4) =	37.2492	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3868.9740	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	673.8863	531.5832	452.9164	271.6594	133.8283	0.0000	0.0000	0.0000	0.0000	266.3459	482.7787	688.4232	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	744.6258	587.3847	500.4601	300.1761	147.8766	0.0000	0.0000	0.0000	0.0000	294.3049	533.4571	760.6886	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8255	89.7674	89.6499	89.3904	88.8676	87.3000	87.3000	87.3000	87.3000	89.3488	89.6975	89.8521	(217)
Fuel for water heating, kWh/month													
	193.2944	169.6045	176.2876	155.6009	151.2741	134.5226	126.2819	142.5977	143.6163	161.5789	173.7922	187.6229	(219)
Water heating fuel used												1916.0739	(219)
Annual totals kWh/year													
Space heating fuel - main system												3868.9740	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5055.2631	(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	3868.9740	0.2160	835.6984	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1916.0739	0.2160	413.8720	(264)
Space and water heating			1249.5703	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			870.8121	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.2600	(273)

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

DER		9.2600	ZC1
Total Floor Area	TFA	94.0000	
Assumed number of occupants	N	2.6766	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5235	ZC2
CO2 emissions from cooking, equation (L16)		1.9493	ZC3
Total CO2 emissions		26.7329	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.7329	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.8187	47.2508	46.8329	43.3936	44.8400	46.8329	47.2508	50.8187	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
								Total per year (kWh/year) = Sum(64)m =				2113.5938	(64)
Heat gains from water heating, kWh/month													
	65.7696	57.8871	60.5649	53.5384	51.7451	45.3971	43.2245	48.4453	48.9886	56.0296	59.6213	64.0963	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	88.4000	86.1415	81.4045	74.3589	69.5498	63.0516	58.0975	65.1147	68.0397	75.3085	82.8073	86.1510	(72)
Total internal gains													
	424.2260	421.9032	406.8408	381.9756	356.6272	332.3736	317.2055	324.2871	337.5375	362.6260	390.6641	411.7631	(73)

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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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)
Northwest	1.5400	11.2829	0.6300	0.7000	0.7700	5.3102	(81)

Solar gains	107.4502	189.5102	276.5154	371.4781	442.4305	450.8189	429.8152	375.1100	309.1225	214.0919	129.8812	91.1911	(83)
Total gains	531.6763	611.4134	683.3562	753.4537	799.0577	783.1925	747.0207	699.3971	646.6600	576.7180	520.5453	502.9542	(84)

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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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9985	0.9966	0.9910	0.9704	0.9052	0.7550	0.5833	0.6400	0.8747	0.9815	0.9968	0.9989	(86)
MIT	19.7658	19.9123	20.1533	20.4759	20.7622	20.9384	20.9872	20.9796	20.8578	20.4891	20.0710	19.7435	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9980	0.9954	0.9876	0.9586	0.8668	0.6675	0.4612	0.5172	0.8108	0.9720	0.9955	0.9985	(89)
MIT 2	18.3331	18.5490	18.9015	19.3728	19.7614	19.9709	20.0088	20.0069	19.8903	19.3987	18.7902	18.3078	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.5922	18.7955	19.1278	19.5723	19.9424	20.1459	20.1858	20.1828	20.0653	19.5959	19.0218	18.5675	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5922	18.7955	19.1278	19.5723	19.9424	20.1459	20.1858	20.1828	20.0653	19.5959	19.0218	18.5675	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9934	0.9837	0.9520	0.8640	0.6803	0.4833	0.5392	0.8151	0.9666	0.9935	0.9977	(94)
Useful gains	530.0258	607.3486	672.1920	717.3106	690.3757	532.8073	361.0701	377.1172	527.0663	557.4690	517.1633	501.7737	(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													
	1505.9838	1459.9856	1323.0535	1103.3226	849.9760	565.1857	365.4296	384.6641	610.7091	927.6789	1235.6731	1497.0686	(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													
	726.1127	572.9721	484.2410	277.9286	118.7426	0.0000	0.0000	0.0000	0.0000	275.4362	517.3271	740.4994	(98)
Space heating												3713.2597	(98)
Space heating per m2											(98) / (4) =	39.5028	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3975.6528	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1127	572.9721	484.2410	277.9286	118.7426	0.0000	0.0000	0.0000	0.0000	275.4362	517.3271	740.4994	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	777.4226	613.4605	518.4593	297.5681	127.1334	0.0000	0.0000	0.0000	0.0000	294.8995	553.8834	792.8259	(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													
	210.4472	185.5169	194.7594	172.7417	167.2445	147.2996	141.1242	157.3204	159.0579	181.1191	191.5481	205.4148	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.9153	87.7020	87.2522	86.2422	84.2062	80.3000	80.3000	80.3000	80.3000	86.1037	87.4286	87.9965	(217)
Fuel for water heating, kWh/month													
	239.3750	211.5311	223.2143	200.2984	198.6130	183.4366	175.7462	195.9159	198.0796	210.3500	219.0910	233.4353	(219)
Water heating fuel used												2489.0864	(219)
Annual totals kWh/year													
Space heating fuel - main system												3975.6528	(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)												413.7723	(232)
Total delivered energy for all uses												6953.5115	(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	3975.6528	0.2160	858.7410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2489.0864	0.2160	537.6427	(264)
Space and water heating			1396.3837	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Total CO2, kg/m2/year			1650.0565	(272)
Emissions per m2 for space and water heating			14.8551	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2846	(272b)
Emissions per m2 for pumps and fans			0.4141	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8551 * 1.00) + 2.2846 + 0.4141, rounded to 2 d.p.			17.5500	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3590	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3320	(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	0.4234	0.4150	0.4067	0.3652	0.3569	0.3154	0.3154	0.3071	0.3320	0.3569	0.3735	0.3901	(22b)
Effective ac	0.5896	0.5861	0.5827	0.5667	0.5637	0.5498	0.5498	0.5472	0.5551	0.5637	0.5698	0.5761	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.2791	47.0001	46.7266	45.4419	45.2016	44.0827	44.0827	43.8755	44.5137	45.2016	45.6878	46.1961	(38)
Heat transfer coeff	107.7598	107.4808	107.2072	105.9226	105.6822	104.5634	104.5634	104.3562	104.9943	105.6822	106.1685	106.6768	(39)
Average = Sum(39)m / 12 =												105.9214	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1464	1.1434	1.1405	1.1268	1.1243	1.1124	1.1124	1.1102	1.1170	1.1243	1.1295	1.1349	(40)
HLP (average)												1.1268	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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Energy content (annual)												Total = Sum(45)m =	1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(65)

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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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(73)

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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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	502.9117	596.5100	684.0248	772.1904	831.2381	819.4798	781.7567	722.4755	657.7639	569.6624	497.3652	472.4164	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8820	34.9725	35.0618	35.4870	35.5677	35.9483	35.9483	36.0197	35.8007	35.5677	35.4048	35.2361	
alpha	3.3255	3.3315	3.3375	3.3658	3.3712	3.3966	3.3966	3.4013	3.3867	3.3712	3.3603	3.3491	
util living area													
	0.9896	0.9810	0.9628	0.9189	0.8311	0.6890	0.5442	0.5979	0.8078	0.9443	0.9827	0.9915	(86)
MIT	19.0411	19.2753	19.6498	20.1345	20.5580	20.8411	20.9474	20.9270	20.7071	20.1505	19.5080	19.0019	(87)
Th 2	19.9631	19.9655	19.9679	19.9790	19.9811	19.9907	19.9907	19.9925	19.9870	19.9811	19.9769	19.9725	(88)
util rest of house													
	0.9874	0.9770	0.9547	0.9004	0.7907	0.6132	0.4361	0.4905	0.7475	0.9279	0.9785	0.9897	(89)
MIT 2	18.1707	18.4048	18.7761	19.2555	19.6511	19.8978	19.9700	19.9614	19.7952	19.2804	18.6459	18.1386	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.3281	18.5622	18.9341	19.4145	19.8151	20.0684	20.1468	20.1360	19.9601	19.4378	18.8018	18.2947	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3281	18.5622	18.9341	19.4145	19.8151	20.0684	20.1468	20.1360	19.9601	19.4378	18.8018	18.2947	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9699	0.9444	0.8880	0.7831	0.6196	0.4538	0.5070	0.7456	0.9167	0.9718	0.9857	(94)
Useful gains	494.2000	578.5335	645.9948	685.6729	650.9662	507.7291	354.7744	366.2928	490.4375	522.2346	483.3466	465.6642	(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													
	1511.6652	1468.4254	1333.0273	1113.7200	857.6272	571.7974	370.8644	389.8741	615.2785	933.9965	1242.3628	1503.5762	(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													
	756.9941	598.0074	511.1521	308.1940	153.7558	0.0000	0.0000	0.0000	0.0000	306.3508	546.4916	772.2065	(98)
Space heating												3953.1523	(98)
Space heating per m2											(98) / (4) =	42.0548	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	982.8955	773.7688	793.1067	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8008	0.8640	0.8358	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	787.1087	668.5042	662.8458	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1060.0280	1013.8205	946.5058	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	196.5019	256.9153	211.0430	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												664.4602	(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	49.1255	64.2288	52.7608	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												166.1150	(107)
Space cooling per m2												1.7672	(108)
Energy for space heating												42.0548	(99)
Energy for space cooling												1.7672	(108)
Total												43.8220	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.8	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3735	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3455	(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	0.4405	0.4318	0.4232	0.3800	0.3714	0.3282	0.3282	0.3195	0.3455	0.3714	0.3886	0.4059	(22b)
Effective ac	0.5970	0.5932	0.5895	0.5722	0.5690	0.5539	0.5539	0.5511	0.5597	0.5690	0.5755	0.5824	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.4800	1.3258	17.8712			(27)
GF B&B J150 P/A=0.40			47.0000	0.1300	6.1100			(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.1800	15.2442			(29a)
Plane Ceiling	47.0000		47.0000	0.1300	6.1100			(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.4654			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.0340	(36)
Total fabric heat loss (33) + (36) =	57.4994	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8714	47.5693	47.2733	45.8828	45.6226	44.4115	44.4115	44.1872	44.8780	45.6226	46.1489	46.6991	(38)
Heat transfer coeff	105.3708	105.0687	104.7727	103.3822	103.1220	101.9109	101.9109	101.6866	102.3774	103.1220	103.6483	104.1985	(39)
Average = Sum(39)m / 12 =												103.3809	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1210	1.1178	1.1146	1.0998	1.0970	1.0842	1.0842	1.0818	1.0891	1.0970	1.1026	1.1085	(40)
HLP (average)												1.0998	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)
Energy content (annual)										Total = Sum(45)m =		1538.2950	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.8913	29.6415	30.5874	26.6668	25.5875	22.0800	20.4604	23.4786	23.7590	27.6888	30.2245	32.8219	(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	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	133.8305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.4295	20.8099	16.9237	12.8124	9.5774	8.0856	8.7368	11.3564	15.2426	19.3540	22.5889	24.0807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	246.2474	248.8027	242.3634	228.6551	211.3508	195.0872	184.2221	181.6668	188.1061	201.8144	219.1187	235.3823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	36.3831	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	45.5528	44.1094	41.1121	37.0373	34.3917	30.6667	27.5005	31.5573	32.9986	37.2162	41.9785	44.1154	(72)
Total internal gains													
	378.3788	376.8711	363.5484	341.6539	318.4691	296.9887	283.6086	287.7297	299.4964	321.5337	346.8353	366.7276	(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	
Northeast	4.1200	11.2829	0.6300	0.7000	0.7700	14.2066	(75)
Southwest	7.8200	36.7938	0.6300	0.7000	0.7700	87.9333	(79)
Northwest	1.5400	11.2829	0.6300	0.7000	0.7700	5.3102	(81)

Solar gains	107.4502	189.5102	276.5154	371.4781	442.4305	450.8189	429.8152	375.1100	309.1225	214.0919	129.8812	91.1911	(83)
Total gains	485.8290	566.3813	640.0638	713.1320	760.8996	747.8076	713.4238	662.8397	608.6189	535.6256	476.7165	457.9187	(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	61.9506	62.1286	62.3042	63.1422	63.3015	64.0538	64.0538	64.1951	63.7619	63.3015	62.9801	62.6475	
alpha	5.1300	5.1419	5.1536	5.2095	5.2201	5.2703	5.2703	5.2797	5.2508	5.2201	5.1987	5.1765	
util living area													
	0.9990	0.9976	0.9932	0.9763	0.9191	0.7780	0.6072	0.6686	0.8955	0.9865	0.9979	0.9993	(86)
MIT	19.7200	19.8678	20.1116	20.4407	20.7380	20.9288	20.9846	20.9751	20.8370	20.4511	20.0275	19.6984	(87)
Th 2	19.9837	19.9864	19.9889	20.0010	20.0032	20.0138	20.0138	20.0157	20.0097	20.0032	19.9987	19.9939	(88)
util rest of house													
	0.9987	0.9968	0.9907	0.9665	0.8844	0.6920	0.4819	0.5434	0.8375	0.9793	0.9970	0.9990	(89)
MIT 2	18.8112	18.9607	19.2054	19.5388	19.8183	19.9792	20.0097	20.0082	19.9135	19.5542	19.1303	18.7977	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.9755	19.1247	19.3693	19.7019	19.9847	20.1509	20.1860	20.1831	20.0805	19.7164	19.2926	18.9606	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9755	19.1247	19.3693	19.7019	19.9847	20.1509	20.1860	20.1831	20.0805	19.7164	19.2926	18.9606	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9958	0.9886	0.9628	0.8836	0.7053	0.5048	0.5661	0.8425	0.9765	0.9961	0.9987	(94)
Useful gains	484.9510	563.9797	632.7612	686.5760	672.3593	527.3947	360.1221	375.2478	512.7727	523.0198	474.8435	457.3108	(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													
	1546.3727	1494.5753	1348.3506	1116.7220	854.3302	565.7001	365.4494	384.6857	612.2651	940.0989	1263.7378	1538.0315	(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													
	789.6977	625.3602	532.3985	309.7051	135.3863	0.0000	0.0000	0.0000	0.0000	310.3069	568.0038	804.0562	(98)
Space heating												4074.9148	(98)
Space heating per m2											(98) / (4) =	43.3502	(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	957.9624	754.1406	772.8182	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8484	0.9155	0.8887	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	812.6951	690.4309	686.8397	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	976.2554	933.9508	876.8016	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	117.7634	181.1788	141.3317	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												440.2739	(104)

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	29.4409	45.2947	35.3329	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												110.0685 (107)
Space cooling per m2												1.1709 (108)
Energy for space heating												43.3502 (99)
Energy for space cooling												1.1709 (108)
Total												44.5211 (109)
Target Fabric Energy Efficiency (TFEE)												51.2 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3590	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3320	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3486	0.3237	0.3320	0.3154	0.3154	0.3071	0.2988	0.2905	0.2822	0.3071	0.2905	0.3071	(22b)
Effective ac	0.5608	0.5524	0.5551	0.5498	0.5498	0.5472	0.5447	0.5422	0.5398	0.5472	0.5422	0.5472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.9667	44.2954	44.5137	44.0827	44.0827	43.8755	43.6738	43.4776	43.2870	43.8755	43.4776	43.8755	(38)
Heat transfer coeff	105.4474	104.7761	104.9943	104.5634	104.5634	104.3562	104.1545	103.9583	103.7677	104.3562	103.9583	104.3562	(39)
Average = Sum(39)m / 12 =												104.4376	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1218	1.1146	1.1170	1.1124	1.1124	1.1102	1.1080	1.1059	1.1039	1.1102	1.1059	1.1102	(40)
HLP (average)												1.1110	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m

	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273 (61)

Total heat required for water heating calculated for each month

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (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

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (64)

Total per year (kWh/year) = Sum(64)m = 1703.8311 (64)
RHI water heating demand 1704 (64)
Heat gains from water heating, kWh/month

	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884 (65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363 (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)

	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644 (71)

Water heating gains (Table 5)

	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747 (72)
Total internal gains												
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618 (73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Northwest	1.5400	14.6176	0.4600	0.0000	0.7700	7.9735	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	154.4406	232.4625	343.8604	468.0336	532.1462	589.8722	557.6542	497.1084	407.1536	283.8700	186.1997	128.7709	(83)
Total gains	766.8440	839.8682	927.2413	1014.2844	1040.3318	1064.2128	1012.4441	960.9947	892.6288	806.6985	750.4084	724.3327	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6469	35.8753	35.8007	35.9483	35.9483	36.0197	36.0894	36.1575	36.2239	36.0197	36.1575	36.0197	
alpha	3.3765	3.3917	3.3867	3.3966	3.3966	3.4013	3.4060	3.4105	3.4149	3.4013	3.4105	3.4013	
util living area	0.9613	0.9472	0.9106	0.8334	0.7084	0.5220	0.3903	0.4087	0.6418	0.8483	0.9366	0.9661	(86)
MIT	19.5450	19.7106	20.0511	20.4575	20.7694	20.9403	20.9832	20.9808	20.8769	20.5175	19.9973	19.5260	(87)
Th 2	19.9831	19.9889	19.9870	19.9907	19.9907	19.9925	19.9943	19.9960	19.9976	19.9925	19.9960	19.9925	(88)
util rest of house	0.9540	0.9374	0.8937	0.8018	0.6534	0.4418	0.2944	0.3091	0.5646	0.8118	0.9227	0.9595	(89)
MIT 2	18.0774	18.3176	18.7987	19.3597	19.7604	19.9491	19.9866	19.9871	19.8957	19.4543	18.7368	18.0570	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3428	18.5696	19.0252	19.5582	19.9429	20.1284	20.1669	20.1668	20.0732	19.6466	18.9648	18.3227	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1928	18.4196	18.8752	19.4082	19.7929	19.9784	20.0169	20.0168	19.9232	19.4966	18.8148	18.1727	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9173	0.8707	0.7807	0.6415	0.4406	0.2966	0.3113	0.5584	0.7903	0.9014	0.9431	(94)
Useful gains	718.0420	770.4512	807.3671	791.8266	667.3796	468.9304	300.2628	299.1433	498.4338	637.5697	676.4342	683.1101	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1401.6938	1374.6151	1246.8325	1036.0371	762.5697	488.2167	303.8049	303.2295	541.9957	844.9299	1134.6795	1374.6490	(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	508.6370	405.9981	326.9623	175.8315	70.8215	0.0000	0.0000	0.0000	0.0000	154.2759	329.9366	514.5050	(98)
Space heating												2486.9679	(98)
RHI space heating demand												2487	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				4.7100	
Infiltration rate				0.3590	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3320	(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	0.4234	0.4150	0.4067	0.3652	0.3569	0.3154	0.3154	0.3071	0.3320	0.3569	0.3735	0.3901	(22b)
Effective ac	0.5896	0.5861	0.5827	0.5667	0.5637	0.5498	0.5498	0.5472	0.5551	0.5637	0.5698	0.5761	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.2791	47.0001	46.7266	45.4419	45.2016	44.0827	44.0827	43.8755	44.5137	45.2016	45.6878	46.1961	(38)
Heat transfer coeff	107.7598	107.4808	107.2072	105.9226	105.6822	104.5634	104.5634	104.3562	104.9943	105.6822	106.1685	106.6768	(39)
Average = Sum(39)m / 12 =												105.9214	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1464	1.1434	1.1405	1.1268	1.1243	1.1124	1.1124	1.1102	1.1170	1.1243	1.1295	1.1349	(40)
HLP (average)												1.1268	(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		2.6766	(42)
Average daily hot water use (litres/day)		97.7695	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
								Total per year (kWh/year) = Sum(64)m =				1703.8311	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(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	
Northeast	4.1200	11.2829	0.4600	0.0000	0.7700	16.4652	(75)
Southwest	4.4900	36.7938	0.4600	0.0000	0.7700	58.5154	(79)
Northwest	1.5400	11.2829	0.4600	0.0000	0.7700	6.1545	(81)
Southwest	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(79)

Solar gains	124.5329	219.6390	320.4764	430.5365	512.7690	522.4911	498.1481	434.7458	358.2674	248.1287	150.5300	105.6888	(83)
Total gains	736.9364	827.0446	903.8573	976.7873	1020.9546	996.8316	952.9381	898.6321	843.7426	770.9572	714.7386	701.2506	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.8820	34.9725	35.0618	35.4870	35.5677	35.9483	35.9483	36.0197	35.8007	35.5677	35.4048	35.2361	
alpha	3.3255	3.3315	3.3375	3.3658	3.3712	3.3966	3.3966	3.4013	3.3867	3.3712	3.3603	3.3491	
util living area													
	0.9690	0.9535	0.9243	0.8627	0.7563	0.6024	0.4609	0.5027	0.7101	0.8853	0.9529	0.9733	(86)
MIT	19.3667	19.5817	19.9163	20.3360	20.6811	20.8956	20.9682	20.9570	20.8099	20.3694	19.7987	19.3251	(87)
Th 2	19.9631	19.9655	19.9679	19.9790	19.9811	19.9907	19.9907	19.9925	19.9870	19.9811	19.9769	19.9725	(88)
util rest of house													
	0.9632	0.9448	0.9098	0.8360	0.7086	0.5269	0.3638	0.4045	0.6409	0.8572	0.9426	0.9682	(89)
MIT 2	17.8077	18.1176	18.5961	19.1881	19.6447	19.9052	19.9733	19.9671	19.8151	19.2481	18.4417	17.7537	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.0897	18.3824	18.8348	19.3957	19.8322	20.0843	20.1532	20.1461	19.9950	19.4509	18.6871	18.0379	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9397	18.2324	18.6848	19.2457	19.6822	19.9343	20.0032	19.9961	19.8450	19.3009	18.5371	17.8879	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9471	0.9253	0.8870	0.8131	0.6929	0.5224	0.3651	0.4049	0.6300	0.8339	0.9231	0.9535	(94)
Useful gains	697.9766	765.3009	801.7202	794.2452	707.4432	520.6978	347.8909	363.8222	531.5779	642.9313	659.7434	668.6565	(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													
	1469.8078	1432.9754	1306.3021	1095.8455	843.5732	557.7720	355.8519	375.2801	603.1927	919.5326	1214.2585	1460.1810	(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													
	574.2424	448.6773	375.4090	217.1522	101.2808	0.0000	0.0000	0.0000	0.0000	205.7914	399.2509	588.8942	(98)
Space heating												2910.6980	(98)
Space heating per m2											(98) / (4) =	30.9649	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3216.2409	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	574.2424	448.6773	375.4090	217.1522	101.2808	0.0000	0.0000	0.0000	0.0000	205.7914	399.2509	588.8942	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	634.5220	495.7760	414.8165	239.9472	111.9125	0.0000	0.0000	0.0000	0.0000	227.3938	441.1612	650.7119	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7363	89.6673	89.5278	89.2231	88.6468	87.3000	87.3000	87.3000	87.3000	89.1527	89.5780	89.7677	(217)
Fuel for water heating, kWh/month													
	193.4864	169.7939	176.5282	155.8928	151.6509	134.5226	126.2819	142.5977	143.6163	161.9344	174.0241	187.7994	(219)
Water heating fuel used												1918.1283	(219)
Annual totals kWh/year													
Space heating fuel - main system												3216.2409	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4404.5845	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3216.2409	3.4800	111.9252	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1918.1283	3.4800	66.7509	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			202.4174	(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] =	0.6116	(257)
SAP value		91.4679	
SAP rating (Section 12)		91	(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	3216.2409	0.2160	694.7080	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1918.1283	0.2160	414.3157	(264)
Space and water heating			1109.0238	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			730.2655	(272)
CO2 emissions per m2			7.7700	(273)
EI value			92.9600	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8871 = 3.923, stars = 4
Water heating environmental impact	0.216 / 0.8871 = 0.2435, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =			30.0000 / (5) =	0.1235	(8)
Pressure test				Yes	
Measured/design AP50				4.7100	
Infiltration rate				0.3590	(18)
Number of sides sheltered				1	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3320	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3486	0.3237	0.3320	0.3154	0.3154	0.3071	0.2988	0.2905	0.2822	0.3071	0.2905	0.3071	(22b)
Effective ac	0.5608	0.5524	0.5551	0.5498	0.5498	0.5472	0.5447	0.5422	0.5398	0.5472	0.5422	0.5472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214	(36)
Total fabric heat loss	(33) + (36) =	60.4807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.9667	44.2954	44.5137	44.0827	44.0827	43.8755	43.6738	43.4776	43.2870	43.8755	43.4776	43.8755	(38)
Heat transfer coeff	105.4474	104.7761	104.9943	104.5634	104.5634	104.3562	104.1545	103.9583	103.7677	104.3562	103.9583	104.3562	(39)
Average = Sum(39)m / 12 =												104.4376	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1218	1.1146	1.1170	1.1124	1.1124	1.1102	1.1080	1.1059	1.1039	1.1102	1.1059	1.1102	(40)
HLP (average)												1.1110	(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		2.6766 (42)
Average daily hot water use (litres/day)		97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual) Total = Sum(45)m = 1538.2950 (45)
Distribution loss (46)m = 0.15 x (45)m

	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273 (61)

Total heat required for water heating calculated for each month

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (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

	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831 (64)

Total per year (kWh/year) = Sum(64)m = 1703.8311 (64)
Heat gains from water heating, kWh/month

	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884 (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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363 (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)

	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644 (71)

Water heating gains (Table 5)

	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747 (72)
Total internal gains												
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618 (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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Northwest	1.5400	14.6176	0.4600	0.0000	0.7700	7.9735	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	154.4406	232.4625	343.8604	468.0336	532.1462	589.8722	557.6542	497.1084	407.1536	283.8700	186.1997	128.7709 (83)
Total gains	766.8440	839.8682	927.2413	1014.2844	1040.3318	1064.2128	1012.4441	960.9947	892.6288	806.6985	750.4084	724.3327 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6469	35.8753	35.8007	35.9483	35.9483	36.0197	36.0894	36.1575	36.2239	36.0197	36.1575	36.0197	
alpha	3.3765	3.3917	3.3867	3.3966	3.3966	3.4013	3.4060	3.4105	3.4149	3.4013	3.4105	3.4013	
util living area													
	0.9613	0.9472	0.9106	0.8334	0.7084	0.5220	0.3903	0.4087	0.6418	0.8483	0.9366	0.9661	(86)
MIT	19.5450	19.7106	20.0511	20.4575	20.7694	20.9403	20.9832	20.9808	20.8769	20.5175	19.9973	19.5260	(87)
Th 2	19.9831	19.9889	19.9870	19.9907	19.9907	19.9925	19.9943	19.9960	19.9976	19.9925	19.9960	19.9925	(88)
util rest of house													
	0.9540	0.9374	0.8937	0.8018	0.6534	0.4418	0.2944	0.3091	0.5646	0.8118	0.9227	0.9595	(89)
MIT 2	18.0774	18.3176	18.7987	19.3597	19.7604	19.9491	19.9866	19.9871	19.8957	19.4543	18.7368	18.0570	(90)
Living area fraction									fLA = Living area / (4) =			0.1809	(91)
MIT	18.3428	18.5696	19.0252	19.5582	19.9429	20.1284	20.1669	20.1668	20.0732	19.6466	18.9648	18.3227	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1928	18.4196	18.8752	19.4082	19.7929	19.9784	20.0169	20.0168	19.9232	19.4966	18.8148	18.1727	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9173	0.8707	0.7807	0.6415	0.4406	0.2966	0.3113	0.5584	0.7903	0.9014	0.9431	(94)
Useful gains	718.0420	770.4512	807.3671	791.8266	667.3796	468.9304	300.2628	299.1433	498.4338	637.5697	676.4342	683.1101	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1401.6938	1374.6151	1246.8325	1036.0371	762.5697	488.2167	303.8049	303.2295	541.9957	844.9299	1134.6795	1374.6490	(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													
	508.6370	405.9981	326.9623	175.8315	70.8215	0.0000	0.0000	0.0000	0.0000	154.2759	329.9366	514.5050	(98)
Space heating												2486.9679	(98)
Space heating per m2											(98) / (4) =	26.4571	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2748.0308	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	508.6370	405.9981	326.9623	175.8315	70.8215	0.0000	0.0000	0.0000	0.0000	154.2759	329.9366	514.5050	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	562.0298	448.6167	361.2843	194.2890	78.2558	0.0000	0.0000	0.0000	0.0000	170.4706	364.5709	568.5138	(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													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6636	89.6042	89.4318	89.0582	88.3782	87.3000	87.3000	87.3000	87.3000	88.9243	89.4479	89.6886	(217)
Fuel for water heating, kWh/month													
	193.6434	169.9133	176.7176	156.1814	152.1117	134.5226	126.2819	142.5977	143.6163	162.3502	174.2770	187.9649	(219)
Water heating fuel used												1920.1780	(219)
Annual totals kWh/year													
Space heating fuel - main system												2748.0308	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3788.0040	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2748.0308	10.2300	281.1236	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1920.1780	10.2300	196.4342	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			257.3466	(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	2748.0308	0.2160	593.5747	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.1780	0.2160	414.7584	(264)
Space and water heating			1008.3331	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			551.5068	(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	2748.0308	1.2200	3352.5976	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1920.1780	1.2200	2342.6171	(264)
Space and water heating			5695.2147	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2992.9860	(272)
Primary energy kWh/m2/year			31.8403	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 85	-191 kg (34.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.04 kg/m²	A 93	A 95
Total Savings	£85	2.04 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£179	£198	-£18
Mains gas	£581	£478	£103
Space heating	£412	£412	£0
Water heating	£196	£112	£85
Lighting	£152	£152	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£257	£173	£85
Total cost of uses	£257	£173	£85
Delivered energy	40 kWh/m²	30 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	32 kWh/m²	20 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000	(1b)	x 2.5400	(2b) =	119.3800	(1b) - (3b)
First floor	47.0000	(1c)	x 2.6300	(2c) =	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000 / (5) =	0.1235	(8)
Pressure test		Yes	
Measured/design AP50		4.7100	
Infiltration rate		0.3590	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3320	(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	0.4234	0.4150	0.4067	0.3652	0.3569	0.3154	0.3154	0.3071	0.3320	0.3569	0.3735	0.3901	(22b)
Effective ac	0.5896	0.5861	0.5827	0.5667	0.5637	0.5498	0.5498	0.5472	0.5551	0.5637	0.5698	0.5761	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.2791	47.0001	46.7266	45.4419	45.2016	44.0827	44.0827	43.8755	44.5137	45.2016	45.6878	46.1961	(38)
Heat transfer coeff	107.7598	107.4808	107.2072	105.9226	105.6822	104.5634	104.5634	104.3562	104.9943	105.6822	106.1685	106.6768	(39)
Average = Sum(39)m / 12 =												105.9214	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1464	1.1434	1.1405	1.1268	1.1243	1.1124	1.1124	1.1102	1.1170	1.1243	1.1295	1.1349	(40)
HLP (average)												1.1268	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

```
Energy content (annual)                                                                          Total = Sum(45)m =   1538.2950 (45)
Distribution loss  (46)m = 0.15 x (45)m
              23.9232    20.9234    21.5911    18.8236    18.0617    15.5859    14.4426    16.5731    16.7711    19.5451    21.3350    23.1684 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1393    12.7601    14.1011    13.6014    14.0221    13.5322    13.9599    14.0003    13.5699    14.0684    13.6542    14.1273 (61)
Total heat required for water heating calculated for each month
             173.6276   152.2495   158.0417   139.0923   134.4337   117.4382   110.2441   124.4878   125.3770   144.3688   155.8872   168.5831 (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                                                                                                                 1.1790 (H8)
Utilisation factor                                                                                                                  0.5718 (H9)
Collector performance factor                                                                                                        0.8793 (H10)
Dedicated solar storage volume                                                                                                     75.0000 (H11)
Effective solar volume                                                                                                             75.0000 (H13)
Daily hot water demand                                                                                                             97.7695 (H14)
Volume ratio Veff/V                                                                                                                 0.7671 (H15)
Solar storage volume factor                                                                                                         0.9470 (H16)
Solar input                                                                                                                      -863.5142 (H17)
Solar input    -25.0402   -41.7849   -71.1644   -95.3744  -117.8270  -115.8427  -114.3118   -99.8748   -78.2220   -53.4164   -29.7013   -20.9544 (63)
                                                                                                 Solar input (sum of months) = Sum(63)m =   -863.5142 (63)
Output from w/h
             148.5874   110.4646    86.8773    43.7179    16.6067     1.5955     0.0000    24.6130    47.1550    90.9524   126.1859   147.6288 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =    844.3846 (64)
Heat gains from water heating, kWh/month
              56.5647    49.5703    51.3855    45.1261    43.5424    37.9318    35.5045    40.2372    40.5683    46.8420    50.7060    54.8884 (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        160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966   160.5966 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              58.5738    52.0247    42.3093    32.0309    23.9435    20.2141    21.8420    28.3911    38.1065    48.3849    56.4723    60.2017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             367.5334   371.3472   361.7365   341.2763   315.4490   291.1749   274.9584   271.1445   280.7553   301.2155   327.0428   351.3169 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363    53.7363 (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)
            -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644  -107.0644 (71)
Water heating gains (Table 5)
              76.0278    73.7653    69.0666    62.6751    58.5247    52.6831    47.7211    54.0822    56.3449    62.9597    70.4250    73.7747 (72)
Total internal gains
             612.4034   607.4057   583.3809   546.2508   508.1856   474.3406   454.7899   463.8863   485.4752   522.8285   564.2087   595.5618 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
Northeast                              4.1200            11.2829           0.4600           0.0000           0.7700           16.4652 (75)
Southwest                              4.4900            36.7938           0.4600           0.0000           0.7700           58.5154 (79)
Northwest                              1.5400            11.2829           0.4600           0.0000           0.7700            6.1545 (81)
Southwest                              3.3300            36.7938           0.4600           0.0000           0.7700           43.3978 (79)
-------------------------------------------------------------------------------------------------------------

Solar gains    124.5329   219.6390   320.4764   430.5365   512.7690   522.4911   498.1481   434.7458   358.2674   248.1287   150.5300   105.6888 (83)
Total gains    736.9364   827.0446   903.8573   976.7873  1020.9546   996.8316   952.9381   898.6321   843.7426   770.9572   714.7386   701.2506 (84)


-------------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                        21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          34.8820    34.9725    35.0618    35.4870    35.5677    35.9483    35.9483    36.0197    35.8007    35.5677    35.4048    35.2361
alpha         3.3255     3.3315     3.3375     3.3658     3.3712     3.3966     3.3966     3.4013     3.3867     3.3712     3.3603     3.3491
util living area
               0.9690     0.9535     0.9243     0.8627     0.7563     0.6024     0.4609     0.5027     0.7101     0.8853     0.9529     0.9733 (86)

MIT           19.3667    19.5817    19.9163    20.3360    20.6811    20.8956    20.9682    20.9570    20.8099    20.3694    19.7987    19.3251 (87)
Th 2          19.9631    19.9655    19.9679    19.9790    19.9811    19.9907    19.9907    19.9925    19.9870    19.9811    19.9769    19.9725 (88)
util rest of house
               0.9632     0.9448     0.9098     0.8360     0.7086     0.5269     0.3638     0.4045     0.6409     0.8572     0.9426     0.9682 (89)
MIT 2         17.8077    18.1176    18.5961    19.1881    19.6447    19.9052    19.9733    19.9671    19.8151    19.2481    18.4417    17.7537 (90)
Living area fraction                                                                                 fLA = Living area / (4) =       0.1809 (91)
MIT           18.0897    18.3824    18.8348    19.3957    19.8322    20.0843    20.1532    20.1461    19.9950    19.4509    18.6871    18.0379 (92)
Temperature adjustment                                                                                                             -0.1500
adjusted MIT  17.9397    18.2324    18.6848    19.2457    19.6822    19.9343    20.0032    19.9961    19.8450    19.3009    18.5371    17.8879 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9471	0.9253	0.8870	0.8131	0.6929	0.5224	0.3651	0.4049	0.6300	0.8339	0.9231	0.9535	(94)
Useful gains	697.9766	765.3009	801.7202	794.2452	707.4432	520.6978	347.8909	363.8222	531.5779	642.9313	659.7434	668.6565	(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	1469.8078	1432.9754	1306.3021	1095.8455	843.5732	557.7720	355.8519	375.2801	603.1927	919.5326	1214.2585	1460.1810	(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	574.2424	448.6773	375.4090	217.1522	101.2808	0.0000	0.0000	0.0000	0.0000	205.7914	399.2509	588.8942	(98)
Space heating												2910.6980	(98)
Space heating per m2											(98) / (4) =	30.9649	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3216.2409	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	574.2424	448.6773	375.4090	217.1522	101.2808	0.0000	0.0000	0.0000	0.0000	205.7914	399.2509	588.8942	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	634.5220	495.7760	414.8165	239.9472	111.9125	0.0000	0.0000	0.0000	0.0000	227.3938	441.1612	650.7119	(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	148.5874	110.4646	86.8773	43.7179	16.6067	1.5955	0.0000	24.6130	47.1550	90.9524	126.1859	147.6288	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8232	89.8493	89.8808	89.9475	90.0351	87.3000	87.3000	87.3000	87.3000	89.4945	89.7103	89.8399	(217)
Fuel for water heating, kWh/month	165.4221	122.9443	96.6583	48.6039	18.4447	1.8276	0.0000	28.1936	54.0149	101.6290	140.6594	164.3242	(219)
Water heating fuel used												942.7220	(219)

Annual totals kWh/year		
Space heating fuel - main system	3216.2409	(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)	413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571	-1218.5571	(233)
Total delivered energy for all uses	3479.1782	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3216.2409	3.4800	111.9252	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	942.7220	3.4800	32.8067	(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	413.7723	13.1900	54.5766	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			175.0683	(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] =	0.5290	(257)
SAP value	92.6207	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3216.2409	0.2160	694.7080	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	942.7220	0.2160	203.6279	(264)
Space and water heating			898.3360	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			545.5277	(272)
CO2 emissions per m2			5.8000	(273)
EI value			94.7410	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.0000 (1b)	x	2.5400 (2b)	=	119.3800	(1b) - (3b)
First floor	47.0000 (1c)	x	2.6300 (2c)	=	123.6100	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.9900	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1235	(8)
Pressure test			Yes	
Measured/design AP50			4.7100	
Infiltration rate			0.3590	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3320	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3486	0.3237	0.3320	0.3154	0.3154	0.3071	0.2988	0.2905	0.2822	0.3071	0.2905	0.3071	(22b)
Effective ac	0.5608	0.5524	0.5551	0.5498	0.5498	0.5472	0.5447	0.5422	0.5398	0.5472	0.5422	0.5472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.1500	1.2357	12.5428			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			47.0000	0.1200	5.6400	75.0000	3525.0000	(28a)
EW Brick AAC015	100.3000	15.6100	84.6900	0.2500	21.1725	52.3000	4429.2870	(29a)
Plane Ceiling	47.0000		47.0000	0.1600	7.5200	9.0000	423.0000	(30)
Total net area of external elements Aum(A, m2)			194.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.7593			(33)
E-WM-30			48.0000	0.0000	0.0000	45.0000	2160.0000	(32)
GF Timber			90.2200			9.0000	811.9800	(32c)
1F Timber			101.5200			9.0000	913.6800	(32c)
Internal Floor			47.0000			18.0000	846.0000	(32d)
Internal Ceiling			47.0000			9.0000	423.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13531.9470 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		143.9569 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7214 (36)
Total fabric heat loss	(33) + (36) =	60.4807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.9667	44.2954	44.5137	44.0827	44.0827	43.8755	43.6738	43.4776	43.2870	43.8755	43.4776	43.8755	(38)
Heat transfer coeff	105.4474	104.7761	104.9943	104.5634	104.5634	104.3562	104.1545	103.9583	103.7677	104.3562	103.9583	104.3562	(39)
Average = Sum(39)m / 12 =												104.4376	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1218	1.1146	1.1170	1.1124	1.1124	1.1102	1.1080	1.1059	1.1039	1.1102	1.1059	1.1102	(40)
HLP (average)												1.1110	(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	2.6766 (42)
Average daily hot water use (litres/day)	97.7695 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.5465	103.6357	99.7249	95.8141	91.9033	87.9926	87.9926	91.9033	95.8141	99.7249	103.6357	107.5465	(44)
Energy conte	159.4883	139.4895	143.9406	125.4909	120.4115	103.9060	96.2842	110.4875	111.8071	130.3004	142.2331	154.4559	(45)

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

Energy content (annual)											Total = Sum(45)m =	1538.2950	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.9232	20.9234	21.5911	18.8236	18.0617	15.5859	14.4426	16.5731	16.7711	19.5451	21.3350	23.1684	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1393	12.7601	14.1011	13.6014	14.0221	13.5322	13.9599	14.0003	13.5699	14.0684	13.6542	14.1273	(61)
Total heat required for water heating calculated for each month													
	173.6276	152.2495	158.0417	139.0923	134.4337	117.4382	110.2441	124.4878	125.3770	144.3688	155.8872	168.5831	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3194	(H8)
Utilisation factor												0.5313	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												97.7695	(H14)
Volume ratio Veff/V												0.7671	(H15)
Solar storage volume factor												0.9470	(H16)
Solar input												-898.0119	(H17)
Solar input	-29.2953	-41.6561	-71.5968	-96.6006	-113.4633	-121.1967	-118.6479	-106.1935	-83.1422	-57.4816	-34.6486	-24.0893	(63)
										Solar input (sum of months) = Sum(63)m =		-898.0119	(63)
Output from w/h													
	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
										Total per year (kWh/year) = Sum(64)m =		817.9815	(64)
Heat gains from water heating, kWh/month													
	56.5647	49.5703	51.3855	45.1261	43.5424	37.9318	35.5045	40.2372	40.5683	46.8420	50.7060	54.8884	(65)

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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	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	160.5966	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.5738	52.0247	42.3093	32.0309	23.9435	20.2141	21.8420	28.3911	38.1065	48.3849	56.4723	60.2017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	367.5334	371.3472	361.7365	341.2763	315.4490	291.1749	274.9584	271.1445	280.7553	301.2155	327.0428	351.3169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	53.7363	(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)													
	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	-107.0644	(71)
Water heating gains (Table 5)													
	76.0278	73.7653	69.0666	62.6751	58.5247	52.6831	47.7211	54.0822	56.3449	62.9597	70.4250	73.7747	(72)
Total internal gains													
	612.4034	607.4057	583.3809	546.2508	508.1856	474.3406	454.7899	463.8863	485.4752	522.8285	564.2087	595.5618	(73)

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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	
Northeast	4.1200	14.6176	0.4600	0.0000	0.7700	21.3316	(75)
Southwest	4.4900	45.1778	0.4600	0.0000	0.7700	71.8489	(79)
Northwest	1.5400	14.6176	0.4600	0.0000	0.7700	7.9735	(81)
Southwest	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(79)

Solar gains	154.4406	232.4625	343.8604	468.0336	532.1462	589.8722	557.6542	497.1084	407.1536	283.8700	186.1997	128.7709	(83)
Total gains	766.8440	839.8682	927.2413	1014.2844	1040.3318	1064.2128	1012.4441	960.9947	892.6288	806.6985	750.4084	724.3327	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6469	35.8753	35.8007	35.9483	35.9483	36.0197	36.0894	36.1575	36.2239	36.0197	36.1575	36.0197	
alpha	3.3765	3.3917	3.3867	3.3966	3.3966	3.4013	3.4060	3.4105	3.4149	3.4013	3.4105	3.4013	
util living area													
	0.9613	0.9472	0.9106	0.8334	0.7084	0.5220	0.3903	0.4087	0.6418	0.8483	0.9366	0.9661	(86)
MIT	19.5450	19.7106	20.0511	20.4575	20.7694	20.9403	20.9832	20.9808	20.8769	20.5175	19.9973	19.5260	(87)
Th 2	19.9831	19.9889	19.9870	19.9907	19.9907	19.9925	19.9943	19.9960	19.9976	19.9925	19.9960	19.9925	(88)
util rest of house													
	0.9540	0.9374	0.8937	0.8018	0.6534	0.4418	0.2944	0.3091	0.5646	0.8118	0.9227	0.9595	(89)
MIT 2	18.0774	18.3176	18.7987	19.3597	19.7604	19.9491	19.9866	19.9871	19.8957	19.4543	18.7368	18.0570	(90)
Living area fraction										fLA = Living area / (4) =		0.1809	(91)
MIT	18.3428	18.5696	19.0252	19.5582	19.9429	20.1284	20.1669	20.1668	20.0732	19.6466	18.9648	18.3227	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1928	18.4196	18.8752	19.4082	19.7929	19.9784	20.0169	20.0168	19.9232	19.4966	18.8148	18.1727	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9364	0.9173	0.8707	0.7807	0.6415	0.4406	0.2966	0.3113	0.5584	0.7903	0.9014	0.9431	(94)
Useful gains	718.0420	770.4512	807.3671	791.8266	667.3796	468.9304	300.2628	299.1433	498.4338	637.5697	676.4342	683.1101	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1401.6938	1374.6151	1246.8325	1036.0371	762.5697	488.2167	303.8049	303.2295	541.9957	844.9299	1134.6795	1374.6490	(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													
	508.6370	405.9981	326.9623	175.8315	70.8215	0.0000	0.0000	0.0000	0.0000	154.2759	329.9366	514.5050	(98)
Space heating												2486.9679	(98)
Space heating per m2											(98) / (4) =	26.4571	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2748.0308	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	508.6370	405.9981	326.9623	175.8315	70.8215	0.0000	0.0000	0.0000	0.0000	154.2759	329.9366	514.5050	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	562.0298	448.6167	361.2843	194.2890	78.2558	0.0000	0.0000	0.0000	0.0000	170.4706	364.5709	568.5138	(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													
	144.3323	110.5935	86.4449	42.4917	20.9704	0.0000	0.0000	18.2943	42.2348	86.8872	121.2386	144.4939	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7726	89.7954	89.8116	89.8589	89.7484	87.3000	87.3000	87.3000	87.3000	89.3204	89.6173	89.7784	(217)
Fuel for water heating, kWh/month													
	160.7754	123.1617	96.2514	47.2871	23.3658	0.0000	0.0000	20.9557	48.3790	97.2758	135.2848	160.9450	(219)
Water heating fuel used												913.6815	(219)
Annual totals kWh/year													
Space heating fuel - main system												2748.0308	(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)												413.7723	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2831.5075	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2748.0308	10.2300	281.1236	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	913.6815	10.2300	93.4696	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	413.7723	36.7200	151.9372	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			172.7420	(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	2748.0308	0.2160	593.5747	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.6815	0.2160	197.3552	(264)
Space and water heating			790.9299	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	413.7723	0.5190	214.7478	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991 (269)
Total kg/year			360.0536 (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	2748.0308	1.2200	3352.5976	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	913.6815	1.2200	1114.6914	(264)
Space and water heating			4467.2891	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	413.7723	3.0700	1270.2811	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1918.5603	(272)
Primary energy kWh/m2/year			20.4102	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	144.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	320.75 (P1)
Transmission heat loss coefficient	60.48 (37)
Summer heat loss coefficient	381.23 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	4.1200	106.0502	0.4600	0.0000	0.9000	180.8877
South West	4.4900	127.3119	0.4600	0.0000	0.9000	236.6549
North West	1.5400	106.0502	0.4600	0.0000	0.9000	67.6134
South West	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						660.6707

	Jun	Jul	Aug	
Solar gains	710	661	587	(P4)
Internal gains	471	452	461	
Total summer gains	1182	1112	1048	(P5)
Summer gain/loss ratio	3.10	2.92	2.75	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 144.0)	0.99	0.99	0.99	
Threshold temperature	19.49	21.21	21.04	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-595.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	4B-As-SEMI
Property	1, Merlin Drive, Botley, Southampton, SO32 2WP		

SAP Rating	90 B	**DER**	10.60	**TER**	16.98
Environmental	91 B	**% DER<TER**	37.57		
CO_2 Emissions (t/year)	0.84	**DFEE**	45.54	**TFEE**	53.89
General Requirements Compliance	Pass	**% DFEE<TFEE**	15.48		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 112 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) 16.98 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.60 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.79 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 5.99 m², No overhang
Windows facing South: 6.14 m², No overhang
Windows facing West: 8.60 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1037	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.3432	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3174	(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	0.4047	0.3968	0.3888	0.3492	0.3412	0.3015	0.3015	0.2936	0.3174	0.3412	0.3571	0.3730	(22b)
Effective ac	0.5819	0.5787	0.5756	0.5610	0.5582	0.5455	0.5455	0.5431	0.5504	0.5582	0.5638	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.5754	55.2716	54.9739	53.5756	53.3140	52.0961	52.0961	51.8705	52.5652	53.3140	53.8432	54.3965	(38)
Heat transfer coeff	132.1897	131.8859	131.5882	130.1899	129.9283	128.7104	128.7104	128.4848	129.1795	129.9283	130.4575	131.0108	(39)
Average = Sum(39)m / 12 =												130.1886	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1807	1.1780	1.1753	1.1628	1.1605	1.1496	1.1496	1.1476	1.1538	1.1605	1.1652	1.1702	(40)
HLP (average)												1.1628	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407	(61)
Total heat required for water heating calculated for each month													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
								Total per year (kWh/year) = Sum(64)m =				1759.8765	(64)
Heat gains from water heating, kWh/month													
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.8721	22.0912	17.9658	13.6012	10.1671	8.5835	9.2748	12.0557	16.1811	20.5456	23.9798	25.5634	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.3424	277.1893	270.0154	254.7430	235.4644	217.3453	205.2405	202.3937	209.5676	224.8400	244.1186	262.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	446.2266	443.9478	427.7795	401.5225	374.5082	348.7512	332.1953	338.7221	352.3665	378.8553	409.3042	432.4783	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.4600	0.0000	0.7700	22.5604	(74)
South	2.8100	46.7521	0.4600	0.0000	0.7700	46.5324	(78)
West	8.6000	19.6403	0.4600	0.0000	0.7700	59.8266	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	184.0629	326.6665	478.1144	638.5093	752.8354	762.7705	729.0792	642.2178	533.8253	369.7980	222.9485	155.8632	(83)
Total gains	630.2895	770.6143	905.8939	1040.0319	1127.3437	1111.5217	1061.2745	980.9399	886.1918	748.6533	632.2526	588.3415	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3777	34.4569	34.5348	34.9058	34.9761	35.3070	35.3070	35.3690	35.1788	34.9761	34.8342	34.6870	
alpha	3.2918	3.2971	3.3023	3.3271	3.3317	3.3538	3.3538	3.3579	3.3453	3.3317	3.3223	3.3125	
util living area													
	0.9884	0.9772	0.9532	0.8977	0.7951	0.6447	0.5012	0.5534	0.7721	0.9324	0.9801	0.9907	(86)
MIT	19.0369	19.3011	19.7041	20.2012	20.6114	20.8661	20.9571	20.9398	20.7415	20.1864	19.5150	18.9897	(87)
Th 2	19.9355	19.9377	19.9398	19.9499	19.9517	19.9605	19.9605	19.9622	19.9571	19.9517	19.9479	19.9439	(88)
util rest of house													
	0.9860	0.9724	0.9433	0.8752	0.7495	0.5663	0.3954	0.4466	0.7057	0.9128	0.9752	0.9887	(89)
MIT 2	17.3128	17.6972	18.2789	18.9865	19.5372	19.8499	19.9369	19.9263	19.7173	18.9818	18.0174	17.2492	(90)
Living area fraction									fLA = Living area / (4) =			0.1697	(91)
MIT	17.6054	17.9694	18.5208	19.1927	19.7195	20.0224	20.1101	20.0983	19.8911	19.1862	18.2716	17.5446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4554	17.8194	18.3708	19.0427	19.5695	19.8724	19.9601	19.9483	19.7411	19.0362	18.1216	17.3946	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9586	0.9231	0.8510	0.7303	0.5591	0.3954	0.4451	0.6897	0.8899	0.9624	0.9812	(94)
Useful gains	615.8767	738.7134	836.2632	885.0559	823.2709	621.4255	419.5948	436.5969	611.1968	666.2107	608.4582	577.3098	(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													
	1739.0117	1703.8839	1562.0551	1320.4731	1022.4689	678.6087	432.4748	455.9024	728.7181	1096.1028	1437.8466	1728.6365	(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													
	835.6124	648.5945	539.9892	313.5004	148.2033	0.0000	0.0000	0.0000	0.0000	319.8397	597.1596	856.5870	(98)
Space heating												4259.4862	(98)
Space heating per m2											(98) / (4) =	38.0447	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4706.6145	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	835.6124	648.5945	539.9892	313.5004	148.2033	0.0000	0.0000	0.0000	0.0000	319.8397	597.1596	856.5870	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	923.3287	716.6791	596.6731	346.4093	163.7605	0.0000	0.0000	0.0000	0.0000	353.4140	659.8449	946.5050	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9174	89.8570	89.7363	89.4694	88.9235	87.3000	87.3000	87.3000	87.3000	89.4574	89.8008	89.9428	(217)
Fuel for water heating, kWh/month													
	199.5531	175.0857	181.9575	160.5806	156.1182	138.8631	130.3040	147.2140	148.2886	166.6855	179.3574	193.6844	(219)
Water heating fuel used												1977.6921	(219)
Annual totals kWh/year													
Space heating fuel - main system												4706.6145	(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)												439.2492	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 853 * 1.00) =										-1009.9874		-1009.9874	(233)
Total delivered energy for all uses												6188.5684	(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	4706.6145	0.2160	1016.6287	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.6921	0.2160	427.1815	(264)
Space and water heating			1443.8102	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)
Energy saving/generation technologies				
PV Unit	-1009.9874	0.5190	-524.1835	(269)
Total CO2, kg/year			1186.5221	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.6000	(273)

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

DER		10.6000	ZC1
Total Floor Area	TFA	111.9600	
Assumed number of occupants	N	2.8261	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.5203	ZC2
CO2 emissions from cooking, equation (L16)		1.6687	ZC3
Total CO2 emissions		26.7890	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.7890	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1382	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3882	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3591	(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	0.4578	0.4489	0.4399	0.3950	0.3860	0.3411	0.3411	0.3322	0.3591	0.3860	0.4040	0.4219	(22b)
Effective ac	0.6048	0.6007	0.5968	0.5780	0.5745	0.5582	0.5582	0.5552	0.5645	0.5745	0.5816	0.5890	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			20.7300	1.3258	27.4830			(27)
GF B&B J150 P/A=0.40			55.9800	0.1300	7.2774			(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.1800	16.7580			(29a)
Plane Ceiling	55.9800		55.9800	0.1300	7.2774			(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9258			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1297	(36)
Total fabric heat loss (33) + (36) =	74.0555	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7639	57.3752	56.9942	55.2046	54.8698	53.3111	53.3111	53.0225	53.9115	54.8698	55.5471	56.2553	(38)
Heat transfer coeff	131.8194	131.4307	131.0497	129.2601	128.9252	127.3666	127.3666	127.0779	127.9669	128.9252	129.6026	130.3107	(39)
Average = Sum(39)m / 12 =												129.2585	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1774	1.1739	1.1705	1.1545	1.1515	1.1376	1.1376	1.1350	1.1430	1.1515	1.1576	1.1639	(40)
HLP (average)												1.1545	(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	2.8261	(42)
Average daily hot water use (litres/day)	101.3197	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)
Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9666	48.5335	44.9693	46.4683	48.5335	48.9666	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.2385	190.5820	200.1263	179.0143	173.3174	152.6483	146.2487	163.0331	164.8336	185.9907	196.7129	211.0234	(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													
	216.2385	190.5820	200.1263	179.0143	173.3174	152.6483	146.2487	163.0331	164.8336	185.9907	196.7129	211.0234	(64)
								Total per year (kWh/year) = Sum(64)m =				2179.7693	(64)
Heat gains from water heating, kWh/month													
	67.6952	59.5713	62.3379	55.4825	53.6240	47.0456	44.7941	50.2045	50.7674	57.6378	61.3385	65.9612	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.8721	22.0912	17.9658	13.6012	10.1671	8.5835	9.2748	12.0557	16.1811	20.5456	23.9798	25.5634	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.3424	277.1893	270.0154	254.7430	235.4644	217.3453	205.2405	202.3937	209.5676	224.8400	244.1186	262.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	90.9882	88.6477	83.7875	77.0591	72.0753	65.3411	60.2071	67.4791	70.5103	77.4702	85.1924	88.6575	(72)
Total internal gains													
	458.5941	456.3195	440.1600	413.7947	386.0982	359.6612	343.1138	350.3199	364.6504	391.2472	421.6822	444.8500	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.6300	0.7000	0.7700	19.4657	(74)
South	6.1400	46.7521	0.6300	0.7000	0.7700	87.7286	(78)
West	8.6000	19.6403	0.6300	0.7000	0.7700	51.6200	(80)

Solar gains	158.8142	281.8563	412.5296	550.9225	649.5660	658.1383	629.0685	554.1223	460.5984	319.0714	192.3657	134.4829	(83)
Total gains	617.4083	738.1759	852.6896	964.7172	1035.6642	1017.7995	972.1823	904.4422	825.2488	710.3185	614.0479	579.3329	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.9822	59.1567	59.3286	60.1501	60.3063	61.0443	61.0443	61.1829	60.7579	60.3063	59.9911	59.6651	
alpha	4.9321	4.9438	4.9552	5.0100	5.0204	5.0696	5.0696	5.0789	5.0505	5.0204	4.9994	4.9777	
util living area													
	0.9986	0.9964	0.9895	0.9640	0.8885	0.7310	0.5609	0.6195	0.8616	0.9802	0.9970	0.9990	(86)
MIT	19.6772	19.8470	20.1171	20.4685	20.7662	20.9402	20.9873	20.9796	20.8556	20.4595	20.0038	19.6525	(87)
Th 2	19.9381	19.9409	19.9437	19.9566	19.9590	19.9702	19.9702	19.9723	19.9659	19.9590	19.9541	19.9490	(88)
util rest of house													
	0.9982	0.9952	0.9857	0.9499	0.8452	0.6397	0.4376	0.4943	0.7928	0.9700	0.9957	0.9987	(89)
MIT 2	18.1715	18.4214	18.8159	19.3271	19.7263	19.9298	19.9655	19.9638	19.8473	19.3232	18.6603	18.1430	(90)
Living area fraction										fLA = Living area / (4) =		0.1697	(91)
MIT	18.4270	18.6633	19.0367	19.5208	19.9028	20.1013	20.1389	20.1362	20.0184	19.5160	18.8883	18.3992	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4270	18.6633	19.0367	19.5208	19.9028	20.1013	20.1389	20.1362	20.0184	19.5160	18.8883	18.3992	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9929	0.9810	0.9423	0.8425	0.6524	0.4585	0.5153	0.7969	0.9639	0.9937	0.9979	(94)
Useful gains	615.6238	732.9504	836.4580	909.0696	872.5407	663.9793	445.7850	466.0671	657.6792	684.6936	610.1778	578.1028	(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													
	1862.2112	1808.9191	1642.9364	1372.8447	1057.5493	700.6756	450.7412	474.7863	757.3653	1149.5039	1527.7918	1850.3019	(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													
	927.4610	723.0510	600.0199	333.9180	137.6464	0.0000	0.0000	0.0000	0.0000	345.8189	660.6821	946.5161	(98)
Space heating												4675.1136	(98)
Space heating per m2											(98) / (4) =	41.7570	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5005.4749	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	927.4610	723.0510	600.0199	333.9180	137.6464	0.0000	0.0000	0.0000	0.0000	345.8189	660.6821	946.5161	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	992.9990	774.1445	642.4196	357.5140	147.3730	0.0000	0.0000	0.0000	0.0000	370.2558	707.3684	1013.4006	(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													
	216.2385	190.5820	200.1263	179.0143	173.3174	152.6483	146.2487	163.0331	164.8336	185.9907	196.7129	211.0234	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3001	88.0888	87.6429	86.5986	84.4778	80.3000	80.3000	80.3000	80.3000	86.5910	87.8645	88.3736	(217)
Fuel for water heating, kWh/month													
	244.8903	216.3521	228.3429	206.7174	205.1632	190.0975	182.1279	203.0300	205.2722	214.7923	223.8822	238.7855	(219)
Water heating fuel used												2559.4537	(219)
Annual totals kWh/year													
Space heating fuel - main system												5005.4749	(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)												439.2492	(232)
Total delivered energy for all uses												8079.1778	(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	5005.4749	0.2160	1081.1826	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2559.4537	0.2160	552.8420	(264)
Space and water heating			1634.0246	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)
Total CO2, kg/m2/year			1900.9199	(272)
Emissions per m2 for space and water heating			14.5947	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0362	(272b)
Emissions per m2 for pumps and fans			0.3477	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5947 * 1.00) + 2.0362 + 0.3477, rounded to 2 d.p.			16.9800	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1382	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.3777	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3494	(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	0.4455	0.4367	0.4280	0.3843	0.3756	0.3319	0.3319	0.3232	0.3494	0.3756	0.3931	0.4105	(22b)
Effective ac	0.5992	0.5954	0.5916	0.5739	0.5705	0.5551	0.5551	0.5522	0.5610	0.5705	0.5772	0.5843	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.2298	56.8618	56.5011	54.8070	54.4901	53.0146	53.0146	52.7413	53.5829	54.4901	55.1313	55.8016	(38)
Heat transfer coeff	133.8441	133.4761	133.1154	131.4213	131.1044	129.6289	129.6289	129.3556	130.1972	131.1044	131.7456	132.4159	(39)
Average = Sum(39)m / 12 =												131.4198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1955	1.1922	1.1890	1.1738	1.1710	1.1578	1.1578	1.1554	1.1629	1.1710	1.1767	1.1827	(40)
HLP (average)												1.1738	(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		2.8261 (42)
Average daily hot water use (litres/day)		101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1219	30.7179	31.6981	27.6351	26.5166	22.8818	21.2033	24.3312	24.6217	28.6943	31.3220	34.0137	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.8721	22.0912	17.9658	13.6012	10.1671	8.5835	9.2748	12.0557	16.1811	20.5456	23.9798	25.5634	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.3424	277.1893	270.0154	254.7430	235.4644	217.3453	205.2405	202.3937	209.5676	224.8400	244.1186	262.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	47.2069	45.7111	42.6049	38.3822	35.6406	31.7803	28.4991	32.7032	34.1969	38.5676	43.5028	45.7173	(72)
Total internal gains													
	411.8128	410.3829	395.9775	372.1178	346.6635	323.1004	308.4058	312.5440	325.3370	349.3445	376.9926	398.9098	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.4600	0.0000	0.7700	22.5604	(74)
South	2.8100	46.7521	0.4600	0.0000	0.7700	46.5324	(78)
West	8.6000	19.6403	0.4600	0.0000	0.7700	59.8266	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	184.0629	326.6665	478.1144	638.5093	752.8354	762.7705	729.0792	642.2178	533.8253	369.7980	222.9485	155.8632	(83)
Total gains	595.8757	737.0494	874.0919	1010.6271	1099.4989	1085.8709	1037.4850	954.7618	859.1623	719.1426	599.9410	554.7731	(84)

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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	33.9528	34.0464	34.1386	34.5787	34.6623	35.0568	35.0568	35.1309	34.9038	34.6623	34.4936	34.3190	
alpha	3.2635	3.2698	3.2759	3.3052	3.3108	3.3371	3.3371	3.3421	3.3269	3.3108	3.2996	3.2879	
util living area													
	0.9902	0.9799	0.9577	0.9050	0.8060	0.6574	0.5134	0.5678	0.7857	0.9393	0.9829	0.9922	(86)
MIT	18.9699	19.2380	19.6489	20.1616	20.5863	20.8557	20.9530	20.9339	20.7221	20.1455	19.4603	18.9271	(87)
Th 2	19.9236	19.9263	19.9288	19.9410	19.9433	19.9539	19.9539	19.9559	19.9498	19.9433	19.9387	19.9339	(88)
util rest of house													
	0.9881	0.9757	0.9485	0.8837	0.7614	0.5787	0.4054	0.4591	0.7206	0.9213	0.9786	0.9905	(89)
MIT 2	18.0698	18.3374	18.7441	19.2485	19.6407	19.8721	19.9362	19.9288	19.7724	19.2447	18.5691	18.0346	(90)
Living area fraction										fLA = Living area / (4) =		0.1697	(91)
MIT	18.2225	18.4902	18.8976	19.4034	19.8012	20.0390	20.1088	20.0994	19.9336	19.3976	18.7204	18.1861	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2225	18.4902	18.8976	19.4034	19.8012	20.0390	20.1088	20.0994	19.9336	19.3976	18.7204	18.1861	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9681	0.9372	0.8706	0.7546	0.5856	0.4222	0.4751	0.7194	0.9094	0.9719	0.9866	(94)
Useful gains	585.9852	713.5247	819.2054	879.8755	829.6418	635.9135	438.0688	453.5648	618.1182	653.9732	583.0568	547.3486	(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													
	1863.4505	1813.9694	1650.3158	1380.3743	1062.0999	705.0503	454.8373	478.5387	759.5127	1153.3989	1530.9311	1851.9783	(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													
	950.4342	739.4988	618.3462	360.3592	172.9488	0.0000	0.0000	0.0000	0.0000	371.5727	682.4695	970.6445	(98)
Space heating												4866.2740	(98)
Space heating per m2											(98) / (4) =	43.4644	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1218.5112	959.2535	983.1026	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8149	0.8747	0.8466	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	992.9947	839.0131	832.2945	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1380.4893	1321.4902	1226.8713	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	278.9961	358.9629	293.5651	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												931.5242	(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	69.7490	89.7407	73.3913	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												232.8811	(107)
Space cooling per m2												2.0800	(108)
Energy for space heating												43.4644	(99)
Energy for space cooling												2.0800	(108)
Total												45.5444	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1382 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.3882 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3591 (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	0.4578	0.4489	0.4399	0.3950	0.3860	0.3411	0.3411	0.3322	0.3591	0.3860	0.4040	0.4219	(22b)
Effective ac	0.6048	0.6007	0.5968	0.5780	0.5745	0.5582	0.5582	0.5552	0.5645	0.5745	0.5816	0.5890	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			20.7300	1.3258	27.4830			(27)
GF B&B J150 P/A=0.40			55.9800	0.1300	7.2774			(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.1800	16.7580			(29a)
Plane Ceiling	55.9800		55.9800	0.1300	7.2774			(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.9258			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1297 (36)
Total fabric heat loss	(33) + (36) =	74.0555 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7639	57.3752	56.9942	55.2046	54.8698	53.3111	53.3111	53.0225	53.9115	54.8698	55.5471	56.2553	(38)
Heat transfer coeff	131.8194	131.4307	131.0497	129.2601	128.9252	127.3666	127.3666	127.0779	127.9669	128.9252	129.6026	130.3107	(39)
Average = Sum(39)m / 12 =												129.2585	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1774	1.1739	1.1705	1.1545	1.1515	1.1376	1.1376	1.1350	1.1430	1.1515	1.1576	1.1639	(40)
HLP (average)												1.1545	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)
Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	35.1219	30.7179	31.6981	27.6351	26.5166	22.8818	21.2033	24.3312	24.6217	28.6943	31.3220	34.0137	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	141.3046	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.8721	22.0912	17.9658	13.6012	10.1671	8.5835	9.2748	12.0557	16.1811	20.5456	23.9798	25.5634	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.3424	277.1893	270.0154	254.7430	235.4644	217.3453	205.2405	202.3937	209.5676	224.8400	244.1186	262.2377	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	37.1305	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	47.2069	45.7111	42.6049	38.3822	35.6406	31.7803	28.4991	32.7032	34.1969	38.5676	43.5028	45.7173	(72)
Total internal gains													
	411.8128	410.3829	395.9775	372.1178	346.6635	323.1004	308.4058	312.5440	325.3370	349.3445	376.9926	398.9098	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.6300	0.7000	0.7700	19.4657	(74)
South	6.1400	46.7521	0.6300	0.7000	0.7700	87.7286	(78)
West	8.6000	19.6403	0.6300	0.7000	0.7700	51.6200	(80)

Solar gains	158.8142	281.8563	412.5296	550.9225	649.5660	658.1383	629.0685	554.1223	460.5984	319.0714	192.3657	134.4829	(83)
Total gains	570.6271	692.2393	808.5070	923.0403	996.2295	981.2387	937.4744	866.6662	785.9354	668.4159	569.3583	533.3927	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.9822	59.1567	59.3286	60.1501	60.3063	61.0443	61.0443	61.1829	60.7579	60.3063	59.9911	59.6651	
alpha	4.9321	4.9438	4.9552	5.0100	5.0204	5.0696	5.0696	5.0789	5.0505	5.0204	4.9994	4.9777	
util living area													
	0.9990	0.9973	0.9916	0.9695	0.9007	0.7494	0.5793	0.6418	0.8793	0.9845	0.9978	0.9993	(86)
MIT	19.6384	19.8093	20.0820	20.4392	20.7470	20.9329	20.9854	20.9762	20.8388	20.4275	19.9669	19.6142	(87)
Th 2	19.9381	19.9409	19.9437	19.9566	19.9590	19.9702	19.9702	19.9723	19.9659	19.9590	19.9541	19.9490	(88)
util rest of house													
	0.9987	0.9964	0.9885	0.9573	0.8604	0.6589	0.4531	0.5143	0.8150	0.9763	0.9969	0.9991	(89)
MIT 2	18.6932	18.8659	19.1392	19.4993	19.7848	19.9388	19.9665	19.9654	19.8734	19.4944	19.0341	18.6777	(90)
Living area fraction									fLA = Living area / (4) =			0.1697	(91)
MIT	18.8536	19.0260	19.2992	19.6588	19.9481	20.1075	20.1394	20.1369	20.0372	19.6527	19.1923	18.8366	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8536	19.0260	19.2992	19.6588	19.9481	20.1075	20.1394	20.1369	20.0372	19.6527	19.1923	18.8366	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9952	0.9859	0.9528	0.8599	0.6721	0.4747	0.5360	0.8203	0.9730	0.9960	0.9987	(94)
Useful gains	569.6129	688.9230	797.1001	879.5155	856.6248	659.5181	445.0140	464.4992	644.6850	650.3898	567.0574	532.7162	(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													
	1918.4484	1856.5929	1677.3319	1390.6835	1063.3898	701.4679	450.8001	474.8790	759.7693	1167.1247	1567.1999	1907.3127	(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													
	1003.5336	784.6742	654.8925	368.0410	153.8331	0.0000	0.0000	0.0000	0.0000	384.4508	720.1026	1022.6998	(98)
Space heating												5092.2276	(98)
Space heating per m2											(98) / (4) =	45.4826	(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	1197.2457	942.5126	965.7922	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8553	0.9190	0.8918	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1023.9593	866.1803	861.3189	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1258.1919	1204.5946	1123.9024	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	168.6475	251.7802	195.3622	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												615.7899	(104)

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	42.1619	62.9451	48.8405	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												153.9475 (107)
Space cooling per m2												1.3750 (108)
Energy for space heating												45.4826 (99)
Energy for space cooling												1.3750 (108)
Total												46.8576 (109)
Target Fabric Energy Efficiency (TFEE)												53.9 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1037	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.3432	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3174	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3333	0.3095	0.3174	0.3015	0.3015	0.2936	0.2857	0.2777	0.2698	0.2936	0.2777	0.2936	(22b)
Effective ac	0.5555	0.5479	0.5504	0.5455	0.5455	0.5431	0.5408	0.5386	0.5364	0.5431	0.5386	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.0584	52.3276	52.5652	52.0961	52.0961	51.8705	51.6510	51.4375	51.2300	51.8705	51.4375	51.8705	(38)
Heat transfer coeff	129.6727	128.9419	129.1795	128.7104	128.7104	128.4848	128.2653	128.0518	127.8443	128.4848	128.0518	128.4848	(39)
Average = Sum(39)m / 12 =												128.5735	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1582	1.1517	1.1538	1.1496	1.1496	1.1476	1.1456	1.1437	1.1419	1.1476	1.1437	1.1476	(40)
HLP (average)												1.1484	(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		2.8261 (42)
Average daily hot water use (litres/day)		101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407	(61)
Total heat required for water heating calculated for each month													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
								Total per year (kWh/year) = Sum(64)m =				1759.8765	(64)
RHI water heating demand												1760	(64)
Heat gains from water heating, kWh/month													
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.1803	55.2280	44.9144	34.0031	25.4177	21.4587	23.1869	30.1392	40.4528	51.3641	59.9494	63.9085	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	409.4663	413.7153	403.0080	380.2135	351.4394	324.3959	306.3292	302.0802	312.7875	335.5820	364.3561	391.3996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	664.5718	659.5238	633.6339	593.3080	551.6470	514.5902	493.1092	502.4052	525.7711	566.3289	611.4245	645.8983	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	13.4839	0.4600	0.0000	0.7700	28.6082	(74)
South	2.8100	56.7559	0.4600	0.0000	0.7700	56.4892	(78)
West	8.6000	25.1925	0.4600	0.0000	0.7700	76.7395	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	228.7797	346.2121	512.7629	692.4324	778.7348	858.2584	813.4493	732.2151	605.8648	423.3823	276.3400	190.3623	(83)
Total gains	893.3515	1005.7359	1146.3968	1285.7404	1330.3818	1372.8486	1306.5585	1234.6203	1131.6360	989.7112	887.7645	836.2606	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.0450	35.2436	35.1788	35.3070	35.3070	35.3690	35.4295	35.4886	35.5462	35.3690	35.4886	35.3690	
alpha	3.3363	3.3496	3.3453	3.3538	3.3538	3.3579	3.3620	3.3659	3.3697	3.3579	3.3659	3.3579	
util living area													
	0.9654	0.9493	0.9076	0.8213	0.6901	0.5012	0.3734	0.3928	0.6274	0.8471	0.9411	0.9705	(86)
MIT	19.4729	19.6644	20.0416	20.4700	20.7802	20.9446	20.9845	20.9820	20.8806	20.5061	19.9464	19.4448	(87)
Th 2	19.9536	19.9589	19.9571	19.9605	19.9605	19.9622	19.9637	19.9653	19.9668	19.9622	19.9653	19.9622	(88)
util rest of house													
	0.9586	0.9396	0.8899	0.7877	0.6330	0.4207	0.2783	0.2936	0.5483	0.8095	0.9277	0.9645	(89)
MIT 2	17.9535	18.2304	18.7625	19.3502	19.7445	19.9229	19.9569	19.9573	19.8698	19.4148	18.6431	17.9194	(90)
Living area fraction									fLA = Living area / (4) =			0.1697	(91)
MIT	18.2113	18.4737	18.9796	19.5402	19.9203	20.0963	20.1313	20.1312	20.0413	19.6000	18.8643	18.1782	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0613	18.3237	18.8296	19.3902	19.7703	19.9463	19.9813	19.9812	19.8913	19.4500	18.7143	18.0282	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9415	0.9193	0.8661	0.7665	0.6216	0.4194	0.2799	0.2952	0.5420	0.7872	0.9062	0.9488	(94)
Useful gains	841.0813	924.5684	992.8806	985.4657	826.9608	575.8288	365.7577	364.4800	613.3450	779.1098	804.4573	793.4805	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1706.6639	1679.3050	1528.1404	1272.9757	935.7567	596.9819	369.5706	368.9399	663.6841	1034.3035	1384.7880	1673.9303	(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													
	643.9935	507.1829	398.2333	207.0072	80.9441	0.0000	0.0000	0.0000	0.0000	189.8642	417.8381	655.0547	(98)
Space heating												3100.1180	(98)
RHI space heating demand												3100	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1037	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.3432	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3174	(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	0.4047	0.3968	0.3888	0.3492	0.3412	0.3015	0.3015	0.2936	0.3174	0.3412	0.3571	0.3730	(22b)
Effective ac	0.5819	0.5787	0.5756	0.5610	0.5582	0.5455	0.5455	0.5431	0.5504	0.5582	0.5638	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.5754	55.2716	54.9739	53.5756	53.3140	52.0961	52.0961	51.8705	52.5652	53.3140	53.8432	54.3965	(38)
Heat transfer coeff	132.1897	131.8859	131.5882	130.1899	129.9283	128.7104	128.7104	128.4848	129.1795	129.9283	130.4575	131.0108	(39)
Average = Sum(39)m / 12 =												130.1886	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1807	1.1780	1.1753	1.1628	1.1605	1.1496	1.1496	1.1476	1.1538	1.1605	1.1652	1.1702	(40)
HLP (average)												1.1628	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407	(61)
Total heat required for water heating calculated for each month													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
								Total per year (kWh/year) = Sum(64)m =				1759.8765	(64)
Heat gains from water heating, kWh/month													
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.1803	55.2280	44.9144	34.0031	25.4177	21.4587	23.1869	30.1392	40.4528	51.3641	59.9494	63.9085	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	409.4663	413.7153	403.0080	380.2135	351.4394	324.3959	306.3292	302.0802	312.7875	335.5820	364.3561	391.3996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	664.5718	659.5238	633.6339	593.3080	551.6470	514.5902	493.1092	502.4052	525.7711	566.3289	611.4245	645.8983	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.4600	0.0000	0.7700	22.5604	(74)
South	2.8100	46.7521	0.4600	0.0000	0.7700	46.5324	(78)
West	8.6000	19.6403	0.4600	0.0000	0.7700	59.8266	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	184.0629	326.6665	478.1144	638.5093	752.8354	762.7705	729.0792	642.2178	533.8253	369.7980	222.9485	155.8632	(83)
Total gains	848.6346	986.1902	1111.7483	1231.8173	1304.4824	1277.3607	1222.1884	1144.6230	1059.5965	936.1269	834.3729	801.7616	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3777	34.4569	34.5348	34.9058	34.9761	35.3070	35.3070	35.3690	35.1788	34.9761	34.8342	34.6870	
alpha	3.2918	3.2971	3.3023	3.3271	3.3317	3.3538	3.3538	3.3579	3.3453	3.3317	3.3223	3.3125	
util living area													
	0.9731	0.9556	0.9223	0.8531	0.7389	0.5832	0.4438	0.4876	0.6994	0.8864	0.9576	0.9773	(86)
MIT	19.2882	19.5359	19.9049	20.3472	20.6955	20.9015	20.9702	20.9589	20.8125	20.3504	19.7381	19.2390	(87)
Th 2	19.9355	19.9377	19.9398	19.9499	19.9517	19.9605	19.9605	19.9622	19.9571	19.9517	19.9479	19.9439	(88)
util rest of house													
	0.9678	0.9471	0.9072	0.8246	0.6889	0.5063	0.3468	0.3886	0.6280	0.8578	0.9480	0.9728	(89)
MIT 2	17.6755	18.0325	18.5590	19.1790	19.6351	19.8815	19.9447	19.9386	19.7904	19.1999	18.3351	17.6100	(90)
Living area fraction									fLA = Living area / (4) =			0.1697	(91)
MIT	17.9492	18.2877	18.7874	19.3772	19.8151	20.0546	20.1187	20.1117	19.9638	19.3952	18.5732	17.8864	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7992	18.1377	18.6374	19.2272	19.6651	19.9046	19.9687	19.9617	19.8138	19.2452	18.4232	17.7364	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9526	0.9276	0.8836	0.8013	0.6736	0.5019	0.3476	0.3886	0.6170	0.8337	0.9287	0.9592	(94)
Useful gains	808.4453	914.7829	982.3926	987.1014	878.6977	641.1538	424.8323	444.7462	653.7660	780.4536	774.9094	769.0190	(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													
	1784.4552	1745.8634	1597.1369	1344.4999	1034.8901	682.7612	433.5855	457.6258	738.1106	1123.2529	1477.1993	1773.4200	(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													
	726.1513	558.4861	457.3698	257.3269	116.2072	0.0000	0.0000	0.0000	0.0000	255.0426	505.6487	747.2744	(98)
Space heating												3623.5070	(98)
Space heating per m2											(98) / (4) =	32.3643	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4003.8751	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1513	558.4861	457.3698	257.3269	116.2072	0.0000	0.0000	0.0000	0.0000	255.0426	505.6487	747.2744	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	802.3772	617.1117	505.3810	284.3391	128.4057	0.0000	0.0000	0.0000	0.0000	281.8150	558.7279	825.7175	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8474	89.7767	89.6356	89.3269	88.7296	87.3000	87.3000	87.3000	87.3000	89.2924	89.7056	89.8772	(217)
Fuel for water heating, kWh/month													
	199.7083	175.2423	182.1619	160.8368	156.4593	138.8631	130.3040	147.2140	148.2886	166.9934	179.5476	193.8258	(219)
Water heating fuel used												1979.4453	(219)
Annual totals kWh/year													
Space heating fuel - main system												4003.8751	(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)												439.2492	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 853 * 1.00) =										-1009.9874		-1009.9874	(233)
Total delivered energy for all uses												5487.5822	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4003.8751	3.4800	139.3349	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1979.4453	3.4800	68.8847	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	439.2492	13.1900	57.9370	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1009.9874	13.1900	-133.2173	(252)
Total energy cost			262.8317	(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] =	0.7033	(257)
SAP value		90.1890	
SAP rating (Section 12)		90	(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	4003.8751	0.2160	864.8370	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1979.4453	0.2160	427.5602	(264)
Space and water heating			1292.3972	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)
Energy saving/generation technologies				
PV Unit	-1009.9874	0.5190	-524.1835	(269)
Total kg/year			1035.1091	(272)
CO2 emissions per m2			9.2500	(273)
EI value			91.1631	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8878 = 3.920, stars = 4
Water heating environmental impact	0.216 / 0.8878 = 0.2433, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1037	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.3432	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3174	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3333	0.3095	0.3174	0.3015	0.3015	0.2936	0.2857	0.2777	0.2698	0.2936	0.2777	0.2936	(22b)
Effective ac	0.5555	0.5479	0.5504	0.5455	0.5455	0.5431	0.5408	0.5386	0.5364	0.5431	0.5386	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.0584	52.3276	52.5652	52.0961	52.0961	51.8705	51.6510	51.4375	51.2300	51.8705	51.4375	51.8705	(38)
Heat transfer coeff	129.6727	128.9419	129.1795	128.7104	128.7104	128.4848	128.2653	128.0518	127.8443	128.4848	128.0518	128.4848	(39)
Average = Sum(39)m / 12 =												128.5735	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1582	1.1517	1.1538	1.1496	1.1496	1.1476	1.1456	1.1437	1.1419	1.1476	1.1437	1.1476	(40)
HLP (average)												1.1484	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

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

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407	(61)
Total heat required for water heating calculated for each month													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
								Total per year (kWh/year) = Sum(64)m =				1759.8765	(64)
Heat gains from water heating, kWh/month													
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.1803	55.2280	44.9144	34.0031	25.4177	21.4587	23.1869	30.1392	40.4528	51.3641	59.9494	63.9085	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	409.4663	413.7153	403.0080	380.2135	351.4394	324.3959	306.3292	302.0802	312.7875	335.5820	364.3561	391.3996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	664.5718	659.5238	633.6339	593.3080	551.6470	514.5902	493.1092	502.4052	525.7711	566.3289	611.4245	645.8983	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	13.4839	0.4600	0.0000	0.7700	28.6082	(74)
South	2.8100	56.7559	0.4600	0.0000	0.7700	56.4892	(78)
West	8.6000	25.1925	0.4600	0.0000	0.7700	76.7395	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	228.7797	346.2121	512.7629	692.4324	778.7348	858.2584	813.4493	732.2151	605.8648	423.3823	276.3400	190.3623	(83)
Total gains	893.3515	1005.7359	1146.3968	1285.7404	1330.3818	1372.8486	1306.5585	1234.6203	1131.6360	989.7112	887.7645	836.2606	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.0450	35.2436	35.1788	35.3070	35.3070	35.3690	35.4295	35.4886	35.5462	35.3690	35.4886	35.3690	
alpha	3.3363	3.3496	3.3453	3.3538	3.3538	3.3579	3.3620	3.3659	3.3697	3.3579	3.3659	3.3579	
util living area													
	0.9654	0.9493	0.9076	0.8213	0.6901	0.5012	0.3734	0.3928	0.6274	0.8471	0.9411	0.9705	(86)
MIT	19.4729	19.6644	20.0416	20.4700	20.7802	20.9446	20.9845	20.9820	20.8806	20.5061	19.9464	19.4448	(87)
Th 2	19.9536	19.9589	19.9571	19.9605	19.9605	19.9622	19.9637	19.9653	19.9668	19.9622	19.9653	19.9622	(88)
util rest of house													
	0.9586	0.9396	0.8899	0.7877	0.6330	0.4207	0.2783	0.2936	0.5483	0.8095	0.9277	0.9645	(89)
MIT 2	17.9535	18.2304	18.7625	19.3502	19.7445	19.9229	19.9569	19.9573	19.8698	19.4148	18.6431	17.9194	(90)
Living area fraction										fLA = Living area / (4) =		0.1697	(91)
MIT	18.2113	18.4737	18.9796	19.5402	19.9203	20.0963	20.1313	20.1312	20.0413	19.6000	18.8643	18.1782	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0613	18.3237	18.8296	19.3902	19.7703	19.9463	19.9813	19.9812	19.8913	19.4500	18.7143	18.0282	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9415	0.9193	0.8661	0.7665	0.6216	0.4194	0.2799	0.2952	0.5420	0.7872	0.9062	0.9488	(94)
Useful gains	841.0813	924.5684	992.8806	985.4657	826.9608	575.8288	365.7577	364.4800	613.3450	779.1098	804.4573	793.4805	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1706.6639	1679.3050	1528.1404	1272.9757	935.7567	596.9819	369.5706	368.9399	663.6841	1034.3035	1384.7880	1673.9303	(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													
	643.9935	507.1829	398.2333	207.0072	80.9441	0.0000	0.0000	0.0000	0.0000	189.8642	417.8381	655.0547	(98)
Space heating												3100.1180	(98)
Space heating per m2											(98) / (4) =	27.6895	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3425.5447	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	643.9935	507.1829	398.2333	207.0072	80.9441	0.0000	0.0000	0.0000	0.0000	189.8642	417.8381	655.0547	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	711.5950	560.4231	440.0368	228.7373	89.4410	0.0000	0.0000	0.0000	0.0000	209.7947	461.6995	723.8174	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7829	89.7214	89.5455	89.1610	88.4519	87.3000	87.3000	87.3000	87.3000	89.0639	89.5864	89.8085	(217)
Fuel for water heating, kWh/month													
	199.8520	175.3504	182.3452	161.1359	156.9505	138.8631	130.3040	147.2140	148.2886	167.4219	179.7867	193.9742	(219)
Water heating fuel used												1981.4865	(219)
Annual totals kWh/year													
Space heating fuel - main system												3425.5447	(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)												439.2492	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 967 * 1.00) =										-1144.6793		-1144.6793	(233)
Total delivered energy for all uses												4776.6011	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3425.5447	10.2300	350.4332	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1981.4865	10.2300	202.7061	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	439.2492	36.7200	161.2923	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1144.6793	36.7200	-420.3262	(252)
Total energy cost			424.6454	(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	3425.5447	0.2160	739.9177	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.4865	0.2160	428.0011	(264)
Space and water heating			1167.9187	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)
Energy saving/generation technologies				
PV Unit	-1144.6793	0.5190	-594.0885	(269)
Total kg/year			840.7255	(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	3425.5447	1.2200	4179.1645	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1981.4865	1.2200	2417.4135	(264)
Space and water heating			6596.5780	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	439.2492	3.0700	1348.4951	(268)
Energy saving/generation technologies				
PV Unit	-1144.6793	3.0700	-3514.1653	(269)
Primary energy kWh/year			4661.1578	(272)

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

Primary energy kWh/m2/year 41.6323 (273)

SAP 2012 EPC IMPROVEMENTS

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

(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	+ 1.0	-£ 87	-196 kg (23.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£87	1.75 kg/m²	B 91	A 93
Total Savings	£87	1.75 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£189	£207	-£18
Mains gas	£656	£551	£105
Space heating	£481	£481	£0
Water heating	£203	£116	£87
Lighting	£161	£161	£0
Generated (PV)	-£420	-£420	£0
Total cost of fuels	£425	£338	£87
Total cost of uses	£425	£338	£87
Delivered energy	43 kWh/m²	34 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	42 kWh/m²	32 kWh/m²	10 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800	(1b)	x 2.5400	(2b) =	142.1892	(1b) - (3b)
First floor	55.9800	(1c)	x 2.6300	(2c) =	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1037	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.3432	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3174	(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	0.4047	0.3968	0.3888	0.3492	0.3412	0.3015	0.3015	0.2936	0.3174	0.3412	0.3571	0.3730	(22b)
Effective ac	0.5819	0.5787	0.5756	0.5610	0.5582	0.5455	0.5455	0.5431	0.5504	0.5582	0.5638	0.5696	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.5754	55.2716	54.9739	53.5756	53.3140	52.0961	52.0961	51.8705	52.5652	53.3140	53.8432	54.3965	(38)
Heat transfer coeff	132.1897	131.8859	131.5882	130.1899	129.9283	128.7104	128.7104	128.4848	129.1795	129.9283	130.4575	131.0108	(39)
Average = Sum(39)m / 12 =												130.1886	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1807	1.1780	1.1753	1.1628	1.1605	1.1496	1.1496	1.1476	1.1538	1.1605	1.1652	1.1702	(40)
HLP (average)												1.1628	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645	(45)
Energy content (annual)										Total = Sum(45)m =		1594.1535	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407	(61)
Total heat required for water heating calculated for each month													
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052	(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												1.1377	(H8)
Utilisation factor												0.5848	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												101.3197	(H14)
Volume ratio Veff/V												0.7402	(H15)
Solar storage volume factor												0.9398	(H16)
Solar input												-876.4736	(H17)
Solar input	-25.4160	-42.4120	-72.2324	-96.8057	-119.5953	-117.5812	-116.0274	-101.3737	-79.3959	-54.2181	-30.1470	-21.2688	(63)
								Solar input (sum of months) = Sum(63)m =				-876.4736	(63)
Output from w/h													
	154.0169	114.9148	91.0495	46.8648	19.2304	3.6463	0.0000	27.1441	50.0600	94.8944	130.9173	152.9364	(64)
									Total per year (kWh/year) = Sum(64)m =			885.6749	(64)
Heat gains from water heating, kWh/month													
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.1803	55.2280	44.9144	34.0031	25.4177	21.4587	23.1869	30.1392	40.4528	51.3641	59.9494	63.9085	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	409.4663	413.7153	403.0080	380.2135	351.4394	324.3959	306.3292	302.0802	312.7875	335.5820	364.3561	391.3996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	664.5718	659.5238	633.6339	593.3080	551.6470	514.5902	493.1092	502.4052	525.7711	566.3289	611.4245	645.8983	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	10.6334	0.4600	0.0000	0.7700	22.5604	(74)
South	2.8100	46.7521	0.4600	0.0000	0.7700	46.5324	(78)
West	8.6000	19.6403	0.4600	0.0000	0.7700	59.8266	(80)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	184.0629	326.6665	478.1144	638.5093	752.8354	762.7705	729.0792	642.2178	533.8253	369.7980	222.9485	155.8632	(83)
Total gains	848.6346	986.1902	1111.7483	1231.8173	1304.4824	1277.3607	1222.1884	1144.6230	1059.5965	936.1269	834.3729	801.7616	(84)

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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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3777	34.4569	34.5348	34.9058	34.9761	35.3070	35.3070	35.3690	35.1788	34.9761	34.8342	34.6870	
alpha	3.2918	3.2971	3.3023	3.3271	3.3317	3.3538	3.3538	3.3579	3.3453	3.3317	3.3223	3.3125	
util living area													
	0.9731	0.9556	0.9223	0.8531	0.7389	0.5832	0.4438	0.4876	0.6994	0.8864	0.9576	0.9773	(86)
MIT	19.2882	19.5359	19.9049	20.3472	20.6955	20.9015	20.9702	20.9589	20.8125	20.3504	19.7381	19.2390	(87)
Th 2	19.9355	19.9377	19.9398	19.9499	19.9517	19.9605	19.9605	19.9622	19.9571	19.9517	19.9479	19.9439	(88)
util rest of house													
	0.9678	0.9471	0.9072	0.8246	0.6889	0.5063	0.3468	0.3886	0.6280	0.8578	0.9480	0.9728	(89)
MIT 2	17.6755	18.0325	18.5590	19.1790	19.6351	19.8815	19.9447	19.9386	19.7904	19.1999	18.3351	17.6100	(90)
Living area fraction									fLA = Living area / (4) =			0.1697	(91)
MIT	17.9492	18.2877	18.7874	19.3772	19.8151	20.0546	20.1187	20.1117	19.9638	19.3952	18.5732	17.8864	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7992	18.1377	18.6374	19.2272	19.6651	19.9046	19.9687	19.9617	19.8138	19.2452	18.4232	17.7364	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9526	0.9276	0.8836	0.8013	0.6736	0.5019	0.3476	0.3886	0.6170	0.8337	0.9287	0.9592	(94)
Useful gains	808.4453	914.7829	982.3926	987.1014	878.6977	641.1538	424.8323	444.7462	653.7660	780.4536	774.9094	769.0190	(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													
	1784.4552	1745.8634	1597.1369	1344.4999	1034.8901	682.7612	433.5855	457.6258	738.1106	1123.2529	1477.1993	1773.4200	(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													
	726.1513	558.4861	457.3698	257.3269	116.2072	0.0000	0.0000	0.0000	0.0000	255.0426	505.6487	747.2744	(98)
Space heating												3623.5070	(98)
Space heating per m2											(98) / (4) =	32.3643	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4003.8751	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	726.1513	558.4861	457.3698	257.3269	116.2072	0.0000	0.0000	0.0000	0.0000	255.0426	505.6487	747.2744	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	802.3772	617.1117	505.3810	284.3391	128.4057	0.0000	0.0000	0.0000	0.0000	281.8150	558.7279	825.7175	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	154.0169	114.9148	91.0495	46.8648	19.2304	3.6463	0.0000	27.1441	50.0600	94.8944	130.9173	152.9364	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9232	89.9374	89.9526	89.9918	90.0314	87.3000	87.3000	87.3000	87.3000	89.6093	89.8229	89.9399	(217)
Fuel for water heating, kWh/month													
	171.2760	127.7720	101.2195	52.0767	21.3597	4.1767	0.0000	31.0929	57.3425	105.8980	145.7506	170.0428	(219)
Water heating fuel used												988.0073	(219)
Annual totals kWh/year													
Space heating fuel - main system												4003.8751	(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)												439.2492	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 853 * 1.00) =											-1009.9874	-1009.9874	(233)
Total delivered energy for all uses												4546.1442	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4003.8751	3.4800	139.3349	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.0073	3.4800	34.3827	(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	439.2492	13.1900	57.9370	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1009.9874	13.1900	-133.2173	(252)
Total energy cost			234.9246	(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] =	0.6286	(257)
SAP value	91.2307	
SAP rating (Section 12)	91	(258)
SAP band	B	

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	4003.8751	0.2160	864.8370	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.0073	0.2160	213.4096	(264)
Space and water heating			1078.2466	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)
Energy saving/generation technologies				
PV Unit	-1009.9874	0.5190	-524.1835	(269)
Total kg/year			846.9085	(272)
CO2 emissions per m2			7.5600	(273)
EI value			92.7698	
EI rating			93	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9800 (1b)	x	2.5400 (2b)	=	142.1892	(1b) - (3b)
First floor	55.9800 (1c)	x	2.6300 (2c)	=	147.2274	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	111.9600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	289.4166	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1037	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.3432	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3174	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3333	0.3095	0.3174	0.3015	0.3015	0.2936	0.2857	0.2777	0.2698	0.2936	0.2777	0.2936	(22b)
Effective ac	0.5555	0.5479	0.5504	0.5455	0.5455	0.5431	0.5408	0.5386	0.5364	0.5431	0.5386	0.5431	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.4000	1.2357	21.5019			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.40			55.9800	0.1200	6.7176	75.0000	4198.5000	(28a)
EW Brick AAC015	115.9600	22.8600	93.1000	0.2500	23.2750	52.3000	4869.1300	(29a)
Plane Ceiling	55.9800		55.9800	0.1600	8.9568	9.0000	503.8200	(30)
Total net area of external elements Aum(A, m2)			227.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3353			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			32.9000			9.0000	296.1000	(32c)
1F Timber			98.0000			9.0000	882.0000	(32c)
GF Masonry			47.0000			39.0000	1833.0000	(32c)
Internal Floor			55.9800			18.0000	1007.6400	(32d)
Internal Ceiling			55.9800			9.0000	503.8200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16359.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.1215 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2790 (36)
Total fabric heat loss	(33) + (36) =	76.6143 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.0584	52.3276	52.5652	52.0961	52.0961	51.8705	51.6510	51.4375	51.2300	51.8705	51.4375	51.8705	(38)
Heat transfer coeff	129.6727	128.9419	129.1795	128.7104	128.7104	128.4848	128.2653	128.0518	127.8443	128.4848	128.0518	128.4848	(39)
Average = Sum(39)m / 12 =												128.5735	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1582	1.1517	1.1538	1.1496	1.1496	1.1476	1.1456	1.1437	1.1419	1.1476	1.1437	1.1476	(40)
HLP (average)												1.1484	(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	2.8261 (42)
Average daily hot water use (litres/day)	101.3197 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4517	107.3989	103.3461	99.2933	95.2405	91.1877	91.1877	95.2405	99.2933	103.3461	107.3989	111.4517	(44)

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

Energy conte	165.2796	144.5546	149.1674	130.0478	124.7839	107.6790	99.7805	114.4995	115.8670	135.0318	147.3978	160.0645 (45)
Energy content (annual)										Total = Sum(45)m =		1594.1535 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.7919	21.6832	22.3751	19.5072	18.7176	16.1519	14.9671	17.1749	17.3801	20.2548	22.1097	24.0097 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1532	12.7722	14.1146	13.6227	14.0418	13.5485	13.9749	14.0183	13.5889	14.0806	13.6666	14.1407 (61)
Total heat required for water heating calculated for each month												
	179.4328	157.3268	163.2820	143.6705	138.8257	121.2275	113.7554	128.5178	129.4559	149.1125	161.0644	174.2052 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2732 (H8)
Utilisation factor												0.5441 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.3197 (H14)
Volume ratio Veff/V												0.7402 (H15)
Solar storage volume factor												0.9398 (H16)
Solar input												-912.5857 (H17)
Solar input	-29.7708	-42.3321	-72.7587	-98.1684	-115.3047	-123.1636	-120.5734	-107.9169	-84.4915	-58.4145	-35.2110	-24.4802 (63)
										Solar input (sum of months) = Sum(63)m =		-912.5857 (63)
Output from w/h												
	149.6621	114.9947	90.5232	45.5021	23.5210	0.0000	0.0000	20.6009	44.9645	90.6980	125.8534	149.7250 (64)
										Total per year (kWh/year) = Sum(64)m =		856.0450 (64)
Heat gains from water heating, kWh/month												
	58.4938	51.2575	53.1268	46.6466	45.0011	39.1904	36.6707	41.5757	41.9230	48.4182	52.4264	56.7566 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	169.5656	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	62.1803	55.2280	44.9144	34.0031	25.4177	21.4587	23.1869	30.1392	40.4528	51.3641	59.9494	63.9085	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	409.4663	413.7153	403.0080	380.2135	351.4394	324.3959	306.3292	302.0802	312.7875	335.5820	364.3561	391.3996	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	54.7827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	-113.0437	(71)
Water heating gains (Table 5)													
	78.6207	76.2760	71.4070	64.7869	60.4854	54.4311	49.2886	55.8813	58.2264	65.0783	72.8145	76.2858	(72)
Total internal gains													
	664.5718	659.5238	633.6339	593.3080	551.6470	514.5902	493.1092	502.4052	525.7711	566.3289	611.4245	645.8983	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.9900	13.4839	0.4600	0.0000	0.7700	28.6082	(74)
South	2.8100	56.7559	0.4600	0.0000	0.7700	56.4892	(78)
West	8.6000	25.1925	0.4600	0.0000	0.7700	76.7395	(80)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	228.7797	346.2121	512.7629	692.4324	778.7348	858.2584	813.4493	732.2151	605.8648	423.3823	276.3400	190.3623 (83)
Total gains	893.3515	1005.7359	1146.3968	1285.7404	1330.3818	1372.8486	1306.5585	1234.6203	1131.6360	989.7112	887.7645	836.2606 (84)

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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, ni1,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	35.0450	35.2436	35.1788	35.3070	35.3070	35.3690	35.4295	35.4886	35.5462	35.3690	35.4886	35.3690
alpha	3.3363	3.3496	3.3453	3.3538	3.3538	3.3579	3.3620	3.3659	3.3697	3.3579	3.3659	3.3579
util living area												
	0.9654	0.9493	0.9076	0.8213	0.6901	0.5012	0.3734	0.3928	0.6274	0.8471	0.9411	0.9705 (86)
MIT	19.4729	19.6644	20.0416	20.4700	20.7802	20.9446	20.9845	20.9820	20.8806	20.5061	19.9464	19.4448 (87)
Th 2	19.9536	19.9589	19.9571	19.9605	19.9605	19.9622	19.9637	19.9653	19.9668	19.9622	19.9653	19.9622 (88)
util rest of house												
	0.9586	0.9396	0.8899	0.7877	0.6330	0.4207	0.2783	0.2936	0.5483	0.8095	0.9277	0.9645 (89)
MIT 2	17.9535	18.2304	18.7625	19.3502	19.7445	19.9229	19.9569	19.9573	19.8698	19.4148	18.6431	17.9194 (90)
Living area fraction									fLA = Living area / (4) =			0.1697 (91)
MIT	18.2113	18.4737	18.9796	19.5402	19.9203	20.0963	20.1313	20.1312	20.0413	19.6000	18.8643	18.1782 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0613	18.3237	18.8296	19.3902	19.7703	19.9463	19.9813	19.9812	19.8913	19.4500	18.7143	18.0282 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9415	0.9193	0.8661	0.7665	0.6216	0.4194	0.2799	0.2952	0.5420	0.7872	0.9062	0.9488	(94)
Useful gains	841.0813	924.5684	992.8806	985.4657	826.9608	575.8288	365.7577	364.4800	613.3450	779.1098	804.4573	793.4805	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1706.6639	1679.3050	1528.1404	1272.9757	935.7567	596.9819	369.5706	368.9399	663.6841	1034.3035	1384.7880	1673.9303	(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													
	643.9935	507.1829	398.2333	207.0072	80.9441	0.0000	0.0000	0.0000	0.0000	189.8642	417.8381	655.0547	(98)
Space heating												3100.1180	(98)
Space heating per m2											(98) / (4) =	27.6895	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3425.5447	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	643.9935	507.1829	398.2333	207.0072	80.9441	0.0000	0.0000	0.0000	0.0000	189.8642	417.8381	655.0547	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	711.5950	560.4231	440.0368	228.7373	89.4410	0.0000	0.0000	0.0000	0.0000	209.7947	461.6995	723.8174	(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													
	149.6621	114.9947	90.5232	45.5021	23.5210	0.0000	0.0000	20.6009	44.9645	90.6980	125.8534	149.7250	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8787	89.8910	89.8897	89.9061	89.7592	87.3000	87.3000	87.3000	87.3000	89.4402	89.7386	89.8870	(217)
Fuel for water heating, kWh/month													
	166.5156	127.9268	100.7047	50.6107	26.2046	0.0000	0.0000	23.5979	51.5057	101.4063	140.2445	166.5702	(219)
Water heating fuel used												955.2870	(219)
Annual totals kWh/year													
Space heating fuel - main system												3425.5447	(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)												439.2492	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 967 * 1.00) =											-1144.6793	-1144.6793	(233)
Total delivered energy for all uses												3800.4016	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3425.5447	10.2300	350.4332	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.2870	10.2300	97.7259	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	439.2492	36.7200	161.2923	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1144.6793	36.7200	-420.3262	(252)
Total energy cost			338.0252	(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	3425.5447	0.2160	739.9177	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.2870	0.2160	206.3420	(264)
Space and water heating			946.2596	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	439.2492	0.5190	227.9703	(268)

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

Energy saving/generation technologies			
PV Unit	-1144.6793	0.5190	-594.0885 (269)
Total kg/year			645.0165 (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	3425.5447	1.2200	4179.1645	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.2870	1.2200	1165.4501	(264)
Space and water heating			5344.6146	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	439.2492	3.0700	1348.4951	(268)
Energy saving/generation technologies				
PV Unit	-1144.6793	3.0700	-3514.1653	(269)
Primary energy kWh/year			3562.6944	(272)
Primary energy kWh/m2/year			31.8211	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	146.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		382.03 (P1)
Transmission heat loss coefficient		76.61 (37)
Summer heat loss coefficient		458.64 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.9900	87.1704	0.4600	0.0000	0.9000	216.1705
South	2.8100	118.5567	0.4600	0.0000	0.9000	137.9217
West	8.6000	125.2818	0.4600	0.0000	0.9000	446.0533
South	3.3300	118.5567	0.4600	0.0000	0.9000	163.4446
total:						963.5901

	Jun	Jul	Aug	
Solar gains	1033	964	864	(P4)
Internal gains	512	490	499	
Total summer gains	1545	1454	1364	(P5)
Summer gain/loss ratio	3.37	3.17	2.97	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 146.1)	0.98	0.98	0.98	
Threshold temperature	19.75	21.45	21.25	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-596.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	4D-As-SEMI
Property	4, Wren Walk, Botley, Southampton, SO32 2DX		

SAP Rating	91 B	**DER**	9.59	**TER**	17.38
Environmental	92 A	**% DER<TER**	44.83		
CO_2 Emissions (t/year)	0.67	**DFEE**	45.55	**TFEE**	53.12
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.26		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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

DWELLING AS BUILT

Semi-Detached House, total floor area 106 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.38 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.59 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.83 (measured in this dwelling)
Maximum 10.0 OK

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

Secondary heating system: None

5 Cylinder insulation
Hot water storage No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 5.44 m², No overhang
Windows facing South: 5.57 m², No overhang
Windows facing West: 2.88 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.036 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Measured/design AP50		4.8300	
Infiltration rate		0.3506	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3243	(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	0.4135	0.4054	0.3972	0.3567	0.3486	0.3081	0.3081	0.3000	0.3243	0.3486	0.3648	0.3810	(22b)
Effective ac	0.5855	0.5822	0.5789	0.5636	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5665	0.5726	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.1402	52.8390	52.5437	51.1567	50.8972	49.6893	49.6893	49.4656	50.1546	50.8972	51.4222	51.9710	(38)
Heat transfer coeff	120.8313	120.5300	120.2347	118.8478	118.5883	117.3803	117.3803	117.1566	117.8456	118.5883	119.1132	119.6621	(39)
Average = Sum(39)m / 12 =												118.8465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1356	1.1328	1.1300	1.1170	1.1146	1.1032	1.1032	1.1011	1.1076	1.1146	1.1195	1.1246	(40)
HLP (average)												1.1170	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
									Total per year (kWh/year) = Sum(64)m =			1746.8695	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(65)

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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	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8619	22.9703	18.6807	14.1425	10.5717	8.9251	9.6438	12.5354	16.8250	21.3632	24.9340	26.5807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.2787	269.0418	262.0788	247.2553	228.5434	210.9568	199.2079	196.4447	203.4078	218.2312	236.9431	254.5297	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	438.0305	435.5764	419.4944	393.5656	367.0164	341.7783	325.6475	332.3149	345.8935	372.0521	402.0081	424.6844	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.4600	0.0000	0.7700	20.4889	(74)
South	5.5700	46.7521	0.4600	0.0000	0.7700	92.2369	(78)
West	2.8800	19.6403	0.4600	0.0000	0.7700	20.0350	(80)

Solar gains	132.7608	229.4082	323.5032	418.4870	485.9597	490.3158	469.4197	417.6829	356.0738	256.0474	159.5891	113.2575	(83)
Total gains	570.7912	664.9846	742.9976	812.0526	852.9761	832.0941	795.0672	749.9978	701.9673	628.0995	561.5972	537.9419	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8690	35.9586	36.0469	36.4676	36.5474	36.9235	36.9235	36.9940	36.7777	36.5474	36.3863	36.2194	
alpha	3.3913	3.3972	3.4031	3.4312	3.4365	3.4616	3.4616	3.4663	3.4518	3.4365	3.4258	3.4146	
util living area													
	0.9901	0.9826	0.9678	0.9334	0.8622	0.7347	0.5897	0.6352	0.8286	0.9492	0.9836	0.9919	(86)
MIT	19.0877	19.3044	19.6495	20.1003	20.5136	20.8142	20.9368	20.9169	20.6930	20.1565	19.5413	19.0503	(87)
Th 2	19.9718	19.9741	19.9764	19.9870	19.9890	19.9982	19.9982	19.9999	19.9947	19.9890	19.9850	19.9808	(88)
util rest of house													
	0.9880	0.9789	0.9606	0.9174	0.8261	0.6610	0.4776	0.5261	0.7713	0.9338	0.9795	0.9901	(89)
MIT 2	17.4082	17.7245	18.2258	18.8773	19.4492	19.8355	19.9610	19.9470	19.6970	18.9673	18.0782	17.3591	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	17.7341	18.0311	18.5021	19.1147	19.6558	20.0254	20.1504	20.1353	19.8903	19.1981	18.3621	17.6874	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5841	17.8811	18.3521	18.9647	19.5058	19.8754	20.0004	19.9853	19.7403	19.0481	18.2121	17.5374	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9805	0.9678	0.9447	0.8963	0.8052	0.6507	0.4779	0.5243	0.7538	0.9142	0.9688	0.9837	(94)
Useful gains	559.6356	643.5916	701.8971	727.8828	686.7876	541.4562	379.9551	393.2547	529.1155	574.2140	544.0589	529.1700	(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													
	1605.1383	1564.6164	1425.0377	1196.1615	925.6776	619.2335	399.1374	420.0392	664.6804	1001.8456	1323.6013	1595.9754	(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													
	777.8540	618.9287	538.0166	337.1607	177.7342	0.0000	0.0000	0.0000	0.0000	318.1580	561.2705	793.7033	(98)
Space heating												4122.8258	(98)
Space heating per m2											(98) / (4) =	38.7484	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4555.6087	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	777.8540	618.9287	538.0166	337.1607	177.7342	0.0000	0.0000	0.0000	0.0000	318.1580	561.2705	793.7033	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	859.5072	683.8991	594.4935	372.5532	196.3913	0.0000	0.0000	0.0000	0.0000	351.5558	620.1884	877.0202	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8862	89.8366	89.7385	89.5246	89.0741	87.3000	87.3000	87.3000	87.3000	89.4589	89.7705	89.9105	(217)
Fuel for water heating, kWh/month													
	198.1234	173.8139	180.5981	159.2947	154.7099	137.8557	129.3705	146.1426	147.2042	165.4523	178.0794	192.3029	(219)
Water heating fuel used												1962.9474	(219)
Annual totals kWh/year													
Space heating fuel - main system												4555.6087	(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)												456.7289	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5772.1278	(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	4555.6087	0.2160	984.0115	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1962.9474	0.2160	423.9966	(264)
Space and water heating			1408.0081	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total CO2, kg/year			1020.6119	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.5900	(273)

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

DER		9.5900	ZC1
Total Floor Area	TFA	106.4000	
Assumed number of occupants	N	2.7914	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8300	ZC2
CO2 emissions from cooking, equation (L16)		1.7481	ZC3
Total CO2 emissions		26.1681	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		26.1681	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000	(1b)	x 2.5400	(2b) =	135.1280	(1b) - (3b)
First floor	53.2000	(1c)	x 2.6300	(2c) =	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1454	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3954	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4572	0.4481	0.4024	0.3932	0.3475	0.3475	0.3383	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6087	0.6045	0.6004	0.5809	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1500	1.2000	2.5800			(26a)
TER Opening Type (Uw = 1.40)			13.8900	1.3258	18.4148			(27)
GF B&B J150 P/A=0.40			53.2000	0.1300	6.9160			(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.1800	15.9462			(29a)
Plane Ceiling	53.2000		53.2000	0.1300	6.9160			(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.9030			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.8928	(36)
Total fabric heat loss (33) + (36) =	63.7958	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.2526	54.8693	54.4936	52.7290	52.3989	50.8620	50.8620	50.5774	51.4540	52.3989	53.0668	53.7650	(38)
Heat transfer coeff	119.0484	118.6651	118.2894	116.5248	116.1947	114.6578	114.6578	114.3731	115.2498	116.1947	116.8626	117.5608	(39)
Average = Sum(39)m / 12 =												116.5232	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1189	1.1153	1.1117	1.0952	1.0921	1.0776	1.0776	1.0749	1.0832	1.0921	1.0983	1.1049	(40)
HLP (average)												1.0951	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)
Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.5684	48.1389	44.6036	46.0904	48.1389	48.5684	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	214.8945	189.4065	198.9133	177.5586	171.9080	151.4070	145.0594	161.7073	163.4932	184.8927	195.5142	209.7217 (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												
	214.8945	189.4065	198.9133	177.5586	171.9080	151.4070	145.0594	161.7073	163.4932	184.8927	195.5142	209.7217 (64)
								Total per year (kWh/year) = Sum(64)m =				2164.4764 (64)
Heat gains from water heating, kWh/month												
	67.2483	59.1804	61.9346	55.0313	53.1880	46.6630	44.4298	49.7962	50.3546	57.2727	60.9400	65.5284 (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	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8619	22.9703	18.6807	14.1425	10.5717	8.9251	9.6438	12.5354	16.8250	21.3632	24.9340	26.5807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.2787	269.0418	262.0788	247.2553	228.5434	210.9568	199.2079	196.4447	203.4078	218.2312	236.9431	254.5297	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	90.3875	88.0661	83.2454	76.4324	71.4892	64.8098	59.7175	66.9304	69.9369	76.9794	84.6389	88.0758	(72)
Total internal gains													
	450.3991	447.9492	431.8759	405.7012	378.4753	352.5626	336.4402	343.7816	358.0407	384.4449	414.3871	437.0572	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.6300	0.7000	0.7700	17.6784	(74)
South	5.5700	46.7521	0.6300	0.7000	0.7700	79.5844	(78)
West	2.8800	19.6403	0.6300	0.7000	0.7700	17.2867	(80)

Solar gains	114.5494	197.9394	279.1270	361.0815	419.2987	423.0573	405.0275	360.3877	307.2297	220.9243	137.6976	97.7215	(83)
Total gains	564.9485	645.8886	711.0028	766.7827	797.7740	775.6199	741.4677	704.1693	665.2704	605.3692	552.0847	534.7787	(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	62.0663	62.2667	62.4645	63.4104	63.5906	64.4430	64.4430	64.6034	64.1120	63.5906	63.2272	62.8516	
alpha	5.1378	5.1511	5.1643	5.2274	5.2394	5.2962	5.2962	5.3069	5.2741	5.2394	5.2151	5.1901	
util living area													
	0.9989	0.9975	0.9938	0.9807	0.9372	0.8170	0.6494	0.6993	0.9053	0.9865	0.9976	0.9992	(86)
MIT	19.7361	19.8752	20.1035	20.4134	20.7030	20.9104	20.9794	20.9699	20.8276	20.4547	20.0433	19.7178	(87)
Th 2	19.9854	19.9884	19.9913	20.0048	20.0073	20.0192	20.0192	20.0214	20.0146	20.0073	20.0022	19.9968	(88)
util rest of house													
	0.9985	0.9966	0.9914	0.9725	0.9081	0.7357	0.5200	0.5732	0.8507	0.9793	0.9966	0.9989	(89)
MIT 2	18.2910	18.4964	18.8313	19.2888	19.6927	19.9527	20.0107	20.0075	19.8631	19.3537	18.7525	18.2724	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.5715	18.7640	19.0782	19.5071	19.8887	20.1386	20.1987	20.1943	20.0503	19.5674	19.0030	18.5529	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5715	18.7640	19.0782	19.5071	19.8887	20.1386	20.1987	20.1943	20.0503	19.5674	19.0030	18.5529	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9951	0.9884	0.9670	0.9038	0.7469	0.5451	0.5973	0.8531	0.9748	0.9951	0.9982	(94)
Useful gains	563.6297	642.7016	702.7215	741.4914	721.0066	579.3018	404.2016	420.5706	567.5368	590.1093	549.3881	533.8390	(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													
	1698.9977	1645.1766	1487.8706	1235.9872	951.4887	635.0389	412.6221	433.9624	685.7723	1041.9638	1391.0186	1687.3433	(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													
	844.7137	673.6632	584.1509	356.0370	171.4787	0.0000	0.0000	0.0000	0.0000	336.1797	605.9739	858.2072	(98)
Space heating												4430.4044	(98)
Space heating per m2											(98) / (4) =	41.6391	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4743.4736	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	844.7137	673.6632	584.1509	356.0370	171.4787	0.0000	0.0000	0.0000	0.0000	336.1797	605.9739	858.2072	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	904.4044	721.2668	625.4292	381.1959	183.5961	0.0000	0.0000	0.0000	0.0000	359.9355	648.7943	918.8514	(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													
	214.8945	189.4065	198.9133	177.5586	171.9080	151.4070	145.0594	161.7073	163.4932	184.8927	195.5142	209.7217	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1514	87.9717	87.6011	86.7684	85.0449	80.3000	80.3000	80.3000	80.3000	86.5378	87.7089	88.2209	(217)
Fuel for water heating, kWh/month													
	243.7789	215.3038	227.0670	204.6351	202.1379	188.5517	180.6469	201.3789	203.6029	213.6554	222.9127	237.7234	(219)
Water heating fuel used												2541.3946	(219)
Annual totals kWh/year													
Space heating fuel - main system												4743.4736	(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)												456.7289	(232)
Total delivered energy for all uses												7816.5971	(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	4743.4736	0.2160	1024.5903	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2541.3946	0.2160	548.9412	(264)
Space and water heating			1573.5315	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Total CO2, kg/m2/year			1849.4988	(272)
Emissions per m2 for space and water heating			14.7888	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2278	(272b)
Emissions per m2 for pumps and fans			0.3658	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7888 * 1.00) + 2.2278 + 0.3658, rounded to 2 d.p.			17.3800	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1454	(8)
Pressure test			Yes	
Measured/design AP50			4.8300	
Infiltration rate			0.3869	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3579	(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	0.4563	0.4474	0.4384	0.3937	0.3848	0.3400	0.3400	0.3311	0.3579	0.3848	0.4027	0.4205	(22b)
Effective ac	0.6041	0.6001	0.5961	0.5775	0.5740	0.5578	0.5578	0.5548	0.5641	0.5740	0.5811	0.5884	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041	(36)
Total fabric heat loss	(33) + (36) =	67.6910	(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	54.8328	54.4658	54.1061	52.4166	52.1005	50.6289	50.6289	50.3564	51.1958	52.1005	52.7400	53.4085	(38)
Heat transfer coeff	122.5239	122.1569	121.7972	120.1076	119.7915	118.3200	118.3200	118.0475	118.8868	119.7915	120.4310	121.0996	(39)
Average = Sum(39)m / 12 =												120.1061	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1515	1.1481	1.1447	1.1288	1.1259	1.1120	1.1120	1.1095	1.1174	1.1259	1.1319	1.1382	(40)
HLP (average)												1.1288	(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	2.7914	(42)
Average daily hot water use (litres/day)	100.4958	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.8363	30.4681	31.4403	27.4104	26.3010	22.6957	21.0309	24.1333	24.4215	28.4609	31.0673	33.7371	(65)

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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	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8619	22.9703	18.6807	14.1425	10.5717	8.9251	9.6438	12.5354	16.8250	21.3632	24.9340	26.5807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.2787	269.0418	262.0788	247.2553	228.5434	210.9568	199.2079	196.4447	203.4078	218.2312	236.9431	254.5297	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	46.8230	45.3394	42.2585	38.0700	35.3507	31.5218	28.2674	32.4372	33.9188	38.2539	43.1491	45.3456	(72)
Total internal gains													
	403.8345	402.2225	387.8890	364.3389	339.3368	316.2747	301.9901	306.2884	319.0226	342.7194	369.8973	391.3270	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.4600	0.0000	0.7700	20.4889	(74)
South	5.5700	46.7521	0.4600	0.0000	0.7700	92.2369	(78)
West	2.8800	19.6403	0.4600	0.0000	0.7700	20.0350	(80)

Solar gains	132.7608	229.4082	323.5032	418.4870	485.9597	490.3158	469.4197	417.6829	356.0738	256.0474	159.5891	113.2575	(83)
Total gains	536.5953	631.6307	711.3921	782.8258	825.2965	806.5905	771.4098	723.9713	675.0963	598.7667	529.4864	504.5845	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.3734	35.4797	35.5845	36.0851	36.1803	36.6303	36.6303	36.7148	36.4556	36.1803	35.9882	35.7895	
alpha	3.3582	3.3653	3.3723	3.4057	3.4120	3.4420	3.4420	3.4477	3.4304	3.4120	3.3992	3.3860	
util living area													
	0.9917	0.9850	0.9716	0.9400	0.8731	0.7498	0.6062	0.6537	0.8431	0.9556	0.9862	0.9933	(86)
MIT	19.0157	19.2361	19.5886	20.0538	20.4807	20.7980	20.9298	20.9075	20.6677	20.1109	19.4823	18.9831	(87)
Th 2	19.9590	19.9618	19.9645	19.9774	19.9798	19.9910	19.9910	19.9931	19.9867	19.9798	19.9749	19.9698	(88)
util rest of house													
	0.9900	0.9819	0.9652	0.9252	0.8386	0.6769	0.4923	0.5435	0.7880	0.9418	0.9828	0.9919	(89)
MIT 2	18.1406	18.3616	18.7127	19.1779	19.5841	19.8693	19.9626	19.9525	19.7646	19.2411	18.6174	18.1160	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.3104	18.5313	18.8827	19.3479	19.7581	20.0495	20.1503	20.1378	19.9399	19.4099	18.7853	18.2843	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3104	18.5313	18.8827	19.3479	19.7581	20.0495	20.1503	20.1378	19.9399	19.4099	18.7853	18.2843	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9861	0.9759	0.9565	0.9138	0.8297	0.6816	0.5117	0.5609	0.7850	0.9318	0.9772	0.9886	(94)
Useful gains	529.1202	616.3932	680.4157	715.3517	684.7862	549.8057	394.7541	406.1011	529.9581	557.9606	517.4151	498.8075	(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													
	1716.6082	1665.1590	1508.1814	1254.8686	965.2953	644.7893	420.0716	441.2411	694.2863	1055.3516	1407.2725	1705.6031	(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													
	883.4911	704.7706	615.8577	388.4522	208.6988	0.0000	0.0000	0.0000	0.0000	370.0589	640.6973	897.8560	(98)
Space heating												4709.8825	(98)
Space heating per m2											(98) / (4) =	44.2658	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1112.2078	875.5678	897.1608	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7529	0.8263	0.7989	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	837.3894	723.4737	716.7805	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1052.1596	1008.7423	955.5455	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	154.6346	212.2398	177.6412	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												544.5155	(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	38.6586	53.0600	44.4103	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												136.1289	(107)
Space cooling per m2												1.2794	(108)
Energy for space heating												44.2658	(99)
Energy for space cooling												1.2794	(108)
Total												45.5452	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1454	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3954	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3658	(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	0.4664	0.4572	0.4481	0.4024	0.3932	0.3475	0.3475	0.3383	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6087	0.6045	0.6004	0.5809	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1500	1.2000	2.5800			(26a)
TER Opening Type (Uw = 1.40)			13.8900	1.3258	18.4148			(27)
GF B&B J150 P/A=0.40			53.2000	0.1300	6.9160			(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.1800	15.9462			(29a)
Plane Ceiling	53.2000		53.2000	0.1300	6.9160			(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.9030			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.8928	(36)
Total fabric heat loss (33) + (36) =	63.7958	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.2526	54.8693	54.4936	52.7290	52.3989	50.8620	50.8620	50.5774	51.4540	52.3989	53.0668	53.7650	(38)
Heat transfer coeff	119.0484	118.6651	118.2894	116.5248	116.1947	114.6578	114.6578	114.3731	115.2498	116.1947	116.8626	117.5608	(39)
Average = Sum(39)m / 12 =												116.5232	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1189	1.1153	1.1117	1.0952	1.0921	1.0776	1.0776	1.0749	1.0832	1.0921	1.0983	1.1049	(40)
HLP (average)												1.0951	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)
Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(59)
Heat gains from water heating, kWh/month												
	34.8363	30.4681	31.4403	27.4104	26.3010	22.6957	21.0309	24.1333	24.4215	28.4609	31.0673	33.7371 (65)

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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	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	139.5701	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8619	22.9703	18.6807	14.1425	10.5717	8.9251	9.6438	12.5354	16.8250	21.3632	24.9340	26.5807	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.2787	269.0418	262.0788	247.2553	228.5434	210.9568	199.2079	196.4447	203.4078	218.2312	236.9431	254.5297	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	36.9570	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	46.8230	45.3394	42.2585	38.0700	35.3507	31.5218	28.2674	32.4372	33.9188	38.2539	43.1491	45.3456	(72)
Total internal gains													
	403.8345	402.2225	387.8890	364.3389	339.3368	316.2747	301.9901	306.2884	319.0226	342.7194	369.8973	391.3270	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.6300	0.7000	0.7700	17.6784	(74)
South	5.5700	46.7521	0.6300	0.7000	0.7700	79.5844	(78)
West	2.8800	19.6403	0.6300	0.7000	0.7700	17.2867	(80)

Solar gains	114.5494	197.9394	279.1270	361.0815	419.2987	423.0573	405.0275	360.3877	307.2297	220.9243	137.6976	97.7215	(83)
Total gains	518.3840	600.1619	667.0159	725.4203	758.6355	739.3320	707.0176	666.6761	626.2523	563.6437	507.5949	489.0485	(84)

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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	62.0663	62.2667	62.4645	63.4104	63.5906	64.4430	64.4430	64.6034	64.1120	63.5906	63.2272	62.8516	
alpha	5.1378	5.1511	5.1643	5.2274	5.2394	5.2962	5.2962	5.3069	5.2741	5.2394	5.2151	5.1901	
util living area													
	0.9993	0.9982	0.9953	0.9847	0.9475	0.8380	0.6747	0.7281	0.9224	0.9901	0.9984	0.9995	(86)
MIT	19.6950	19.8351	20.0655	20.3798	20.6773	20.8978	20.9754	20.9636	20.8056	20.4198	20.0042	19.6773	(87)
Th 2	19.9854	19.9884	19.9913	20.0048	20.0073	20.0192	20.0192	20.0214	20.0146	20.0073	20.0022	19.9968	(88)
util rest of house													
	0.9990	0.9976	0.9935	0.9781	0.9221	0.7601	0.5433	0.6015	0.8740	0.9847	0.9977	0.9993	(89)
MIT 2	18.7875	18.9298	19.1618	19.4837	19.7703	19.9661	20.0121	20.0095	19.8946	19.5273	19.1099	18.7790	(90)
Living area fraction										fLA = Living area / (4) =		0.1941	(91)
MIT	18.9636	19.1055	19.3372	19.6576	19.9463	20.1469	20.1991	20.1947	20.0714	19.7005	19.2835	18.9533	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9636	19.1055	19.3372	19.6576	19.9463	20.1469	20.1991	20.1947	20.0714	19.7005	19.2835	18.9533	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9968	0.9919	0.9750	0.9201	0.7718	0.5691	0.6261	0.8775	0.9824	0.9970	0.9990	(94)
Useful gains	517.6717	598.2671	661.6390	707.3029	698.0375	570.6077	402.3935	417.3760	549.5149	553.7058	506.0857	488.5563	(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													
	1745.6833	1685.6945	1518.5042	1253.5281	958.1743	635.9959	412.6615	434.0113	688.2009	1057.4341	1423.7940	1734.4134	(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													
	913.6406	730.7512	637.5077	393.2821	193.5418	0.0000	0.0000	0.0000	0.0000	374.7739	660.7500	926.9177	(98)
Space heating												4831.1650	(98)
Space heating per m2											(98) / (4) =	45.4057	(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	1077.7829	848.4674	869.2359	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7955	0.8785	0.8506	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	857.3771	745.3372	739.3320	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	973.5457	933.4788	888.5771	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	83.6414	139.9773	111.0384	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												334.6571 (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	20.9103	34.9943	27.7596	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												83.6643 (107)
Space cooling per m2												0.7863 (108)
Energy for space heating												45.4057 (99)
Energy for space cooling												0.7863 (108)
Total												46.1920 (109)
Target Fabric Energy Efficiency (TFEE)												53.1 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Measured/design AP50		4.8300	
Infiltration rate		0.3506	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3243	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3405	0.3162	0.3243	0.3081	0.3081	0.3000	0.2919	0.2837	0.2756	0.3000	0.2837	0.3000	(22b)
Effective ac	0.5580	0.5500	0.5526	0.5475	0.5475	0.5450	0.5426	0.5403	0.5380	0.5450	0.5403	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6437	49.9189	50.1546	49.6893	49.6893	49.4656	49.2478	49.0361	48.8302	49.4656	49.0361	49.4656	(38)
Heat transfer coeff	118.3348	117.6100	117.8456	117.3803	117.3803	117.1566	116.9389	116.7271	116.5213	117.1566	116.7271	117.1566	(39)
Average = Sum(39)m / 12 =												117.2446	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1122	1.1054	1.1076	1.1032	1.1032	1.1011	1.0990	1.0971	1.0951	1.1011	1.0971	1.1011	(40)
HLP (average)												1.1019	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
									Total per year (kWh/year) = Sum(64)m =			1746.8695	(64)
RHI water heating demand												1747	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(65)

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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	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6547	57.4257	46.7017	35.3562	26.4292	22.3126	24.1096	31.3386	42.0626	53.4081	62.3351	66.4517	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.4308	401.5549	391.1623	369.0378	341.1095	314.8609	297.3252	293.2011	303.5937	325.7182	353.6465	379.8951	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	653.4723	648.0418	622.0958	582.0586	540.9369	504.5668	483.7274	493.3712	516.8138	557.0808	601.6094	635.4176	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	13.4839	0.4600	0.0000	0.7700	25.9814	(74)
South	5.5700	56.7559	0.4600	0.0000	0.7700	111.9733	(78)
West	2.8800	25.1925	0.4600	0.0000	0.7700	25.6988	(80)

Solar gains	163.6535	241.0425	344.2535	451.5017	501.3434	550.7959	522.6615	474.2923	401.3496	290.6579	196.1431	137.2146	(83)
Total gains	817.1258	889.0843	966.3494	1033.5604	1042.2802	1055.3627	1006.3890	967.6635	918.1634	847.7387	797.7524	772.6322	(84)

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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	36.6257	36.8514	36.7777	36.9235	36.9235	36.9940	37.0629	37.1301	37.1957	36.9940	37.1301	36.9940	
alpha	3.4417	3.4568	3.4518	3.4616	3.4616	3.4663	3.4709	3.4753	3.4797	3.4663	3.4753	3.4663	
util living area													
	0.9683	0.9569	0.9280	0.8664	0.7586	0.5781	0.4368	0.4517	0.6833	0.8711	0.9473	0.9722	(86)
MIT	19.5242	19.6784	20.0011	20.3966	20.7251	20.9234	20.9781	20.9758	20.8579	20.4868	19.9711	19.5073	(87)
Th 2	19.9909	19.9965	19.9947	19.9982	19.9982	19.9999	20.0016	20.0032	20.0048	19.9999	20.0032	19.9999	(88)
util rest of house													
	0.9620	0.9486	0.9136	0.8386	0.7063	0.4941	0.3320	0.3442	0.6063	0.8379	0.9352	0.9667	(89)
MIT 2	18.0512	18.2759	18.7347	19.2873	19.7182	19.9431	19.9915	19.9919	19.8851	19.4214	18.7043	18.0334	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.3371	18.5481	18.9805	19.5026	19.9136	20.1333	20.1830	20.1829	20.0739	19.6282	18.9502	18.3194	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1871	18.3981	18.8305	19.3526	19.7636	19.9833	20.0330	20.0329	19.9239	19.4782	18.8002	18.1694	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9308	0.8924	0.8173	0.6925	0.4926	0.3354	0.3476	0.5994	0.8168	0.9160	0.9524	(94)
Useful gains	773.4853	827.5417	862.3253	844.7356	721.8179	519.8436	337.5416	336.3124	550.3665	692.3947	730.7026	735.8711	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1572.3226	1540.4634	1394.1682	1156.4982	852.6051	548.6839	342.9765	342.3483	608.6969	946.4116	1272.3437	1542.8869	(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													
	594.3350	479.0834	395.6911	224.4691	97.3057	0.0000	0.0000	0.0000	0.0000	188.9886	389.9816	600.4198	(98)
Space heating												2970.2741	(98)
RHI space heating demand												2970	(98)

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Measured/design AP50		4.8300	
Infiltration rate		0.3506	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3243	(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	0.4135	0.4054	0.3972	0.3567	0.3486	0.3081	0.3081	0.3000	0.3243	0.3486	0.3648	0.3810	(22b)
Effective ac	0.5855	0.5822	0.5789	0.5636	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5665	0.5726	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.1402	52.8390	52.5437	51.1567	50.8972	49.6893	49.6893	49.4656	50.1546	50.8972	51.4222	51.9710	(38)
Heat transfer coeff	120.8313	120.5300	120.2347	118.8478	118.5883	117.3803	117.3803	117.1566	117.8456	118.5883	119.1132	119.6621	(39)
Average = Sum(39)m / 12 =												118.8465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1356	1.1328	1.1300	1.1170	1.1146	1.1032	1.1032	1.1011	1.1076	1.1146	1.1195	1.1246	(40)
HLP (average)												1.1170	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

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Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
									Total per year (kWh/year) = Sum(64)m =			1746.8695	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(65)

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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	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6547	57.4257	46.7017	35.3562	26.4292	22.3126	24.1096	31.3386	42.0626	53.4081	62.3351	66.4517	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.4308	401.5549	391.1623	369.0378	341.1095	314.8609	297.3252	293.2011	303.5937	325.7182	353.6465	379.8951	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	653.4723	648.0418	622.0958	582.0586	540.9369	504.5668	483.7274	493.3712	516.8138	557.0808	601.6094	635.4176	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.4600	0.0000	0.7700	20.4889	(74)
South	5.5700	46.7521	0.4600	0.0000	0.7700	92.2369	(78)
West	2.8800	19.6403	0.4600	0.0000	0.7700	20.0350	(80)

Solar gains	132.7608	229.4082	323.5032	418.4870	485.9597	490.3158	469.4197	417.6829	356.0738	256.0474	159.5891	113.2575	(83)
Total gains	786.2330	877.4500	945.5990	1000.5456	1026.8966	994.8825	953.1471	911.0542	872.8875	813.1281	761.1985	748.6751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8690	35.9586	36.0469	36.4676	36.5474	36.9235	36.9235	36.9940	36.7777	36.5474	36.3863	36.2194	
alpha	3.3913	3.3972	3.4031	3.4312	3.4365	3.4616	3.4616	3.4663	3.4518	3.4365	3.4258	3.4146	
util living area													
	0.9746	0.9619	0.9388	0.8904	0.8014	0.6572	0.5100	0.5482	0.7471	0.9034	0.9610	0.9782	(86)
MIT	19.3525	19.5555	19.8719	20.2761	20.6294	20.8707	20.9597	20.9476	20.7865	20.3397	19.7782	19.3127	(87)
Th 2	19.9718	19.9741	19.9764	19.9870	19.9890	19.9982	19.9982	19.9999	19.9947	19.9890	19.9850	19.9808	(88)
util rest of house													
	0.9697	0.9545	0.9265	0.8672	0.7574	0.5809	0.4063	0.4451	0.6801	0.8782	0.9522	0.9739	(89)
MIT 2	17.7908	18.0846	18.5394	19.1150	19.5910	19.8899	19.9756	19.9684	19.7984	19.2147	18.4166	17.7392	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.0939	18.3700	18.7980	19.3404	19.7925	20.0802	20.1666	20.1584	19.9901	19.4330	18.6808	18.0446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9439	18.2200	18.6480	19.1904	19.6425	19.9302	20.0166	20.0084	19.8401	19.2830	18.5308	17.8946	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9558	0.9374	0.9058	0.8450	0.7400	0.5752	0.4083	0.4461	0.6684	0.8561	0.9349	0.9614	(94)
Useful gains	751.4985	822.4954	856.5455	845.4331	759.9381	572.3031	389.1911	406.3949	583.4028	696.1149	711.6319	719.7418	(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													
	1648.6108	1605.4642	1460.6132	1222.9886	941.8930	625.6618	401.0445	422.7509	676.4513	1029.7030	1361.5616	1638.7194	(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													
	667.4516	526.1551	449.4263	271.8400	135.3745	0.0000	0.0000	0.0000	0.0000	248.1896	467.9494	683.7194	(98)
Space heating												3450.1058	(98)
Space heating per m2											(98) / (4) =	32.4258	(99)

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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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3812.2716	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	667.4516	526.1551	449.4263	271.8400	135.3745	0.0000	0.0000	0.0000	0.0000	248.1896	467.9494	683.7194	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	737.5156	581.3868	496.6037	300.3756	149.5850	0.0000	0.0000	0.0000	0.0000	274.2426	517.0712	755.4910	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8067	89.7471	89.6293	89.3728	88.8570	87.3000	87.3000	87.3000	87.3000	89.2775	89.6631	89.8354	(217)
Fuel for water heating, kWh/month													
	198.2988	173.9871	180.8182	159.5653	155.0878	137.8557	129.3705	146.1426	147.2042	165.7885	178.2928	192.4637	(219)
Water heating fuel used												1964.8752	(219)
Annual totals kWh/year													
Space heating fuel - main system												3812.2716	(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)												456.7289	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												5030.7185	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3812.2716	3.4800	132.6671	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1964.8752	3.4800	68.3777	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	456.7289	13.1900	60.2425	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			222.5908	(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] =	0.6175	(257)
SAP value		91.3860	
SAP rating (Section 12)		91	(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	3812.2716	0.2160	823.4507	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1964.8752	0.2160	424.4130	(264)
Space and water heating			1247.8637	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			860.4675	(272)
CO2 emissions per m2			8.0900	(273)
EI value			92.3842	
EI rating			92	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8878 = 3.920, stars = 4
Water heating environmental impact	0.216 / 0.8878 = 0.2433, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000	(1b)	x 2.5400	(2b) =	135.1280	(1b) - (3b)
First floor	53.2000	(1c)	x 2.6300	(2c) =	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =		30.0000 / (5) =	0.1091	(8)
Pressure test			Yes	
Measured/design AP50			4.8300	
Infiltration rate			0.3506	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3243	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3405	0.3162	0.3243	0.3081	0.3081	0.3000	0.2919	0.2837	0.2756	0.3000	0.2837	0.3000	(22b)
Effective ac	0.5580	0.5500	0.5526	0.5475	0.5475	0.5450	0.5426	0.5403	0.5380	0.5450	0.5403	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6437	49.9189	50.1546	49.6893	49.6893	49.4656	49.2478	49.0361	48.8302	49.4656	49.0361	49.4656	(38)
Heat transfer coeff	118.3348	117.6100	117.8456	117.3803	117.3803	117.1566	116.9389	116.7271	116.5213	117.1566	116.7271	117.1566	(39)
Average = Sum(39)m / 12 =												117.2446	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1122	1.1054	1.1076	1.1032	1.1032	1.1011	1.0990	1.0971	1.0951	1.1011	1.0971	1.1011	(40)
HLP (average)												1.1019	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

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

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
									Total per year (kWh/year) = Sum(64)m =			1746.8695	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(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	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6547	57.4257	46.7017	35.3562	26.4292	22.3126	24.1096	31.3386	42.0626	53.4081	62.3351	66.4517	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.4308	401.5549	391.1623	369.0378	341.1095	314.8609	297.3252	293.2011	303.5937	325.7182	353.6465	379.8951	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	653.4723	648.0418	622.0958	582.0586	540.9369	504.5668	483.7274	493.3712	516.8138	557.0808	601.6094	635.4176	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	13.4839	0.4600	0.0000	0.7700	25.9814	(74)
South	5.5700	56.7559	0.4600	0.0000	0.7700	111.9733	(78)
West	2.8800	25.1925	0.4600	0.0000	0.7700	25.6988	(80)

Solar gains	163.6535	241.0425	344.2535	451.5017	501.3434	550.7959	522.6615	474.2923	401.3496	290.6579	196.1431	137.2146	(83)
Total gains	817.1258	889.0843	966.3494	1033.5604	1042.2802	1055.3627	1006.3890	967.6635	918.1634	847.7387	797.7524	772.6322	(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	36.6257	36.8514	36.7777	36.9235	36.9235	36.9940	37.0629	37.1301	37.1957	36.9940	37.1301	36.9940	
alpha	3.4417	3.4568	3.4518	3.4616	3.4616	3.4663	3.4709	3.4753	3.4797	3.4663	3.4753	3.4663	
util living area													
	0.9683	0.9569	0.9280	0.8664	0.7586	0.5781	0.4368	0.4517	0.6833	0.8711	0.9473	0.9722	(86)
MIT	19.5242	19.6784	20.0011	20.3966	20.7251	20.9234	20.9781	20.9758	20.8579	20.4868	19.9711	19.5073	(87)
Th 2	19.9909	19.9965	19.9947	19.9982	19.9982	19.9999	20.0016	20.0032	20.0048	19.9999	20.0032	19.9999	(88)
util rest of house													
	0.9620	0.9486	0.9136	0.8386	0.7063	0.4941	0.3320	0.3442	0.6063	0.8379	0.9352	0.9667	(89)
MIT 2	18.0512	18.2759	18.7347	19.2873	19.7182	19.9431	19.9915	19.9919	19.8851	19.4214	18.7043	18.0334	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.3371	18.5481	18.9805	19.5026	19.9136	20.1333	20.1830	20.1829	20.0739	19.6282	18.9502	18.3194	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1871	18.3981	18.8305	19.3526	19.7636	19.9833	20.0330	20.0329	19.9239	19.4782	18.8002	18.1694	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9308	0.8924	0.8173	0.6925	0.4926	0.3354	0.3476	0.5994	0.8168	0.9160	0.9524	(94)
Useful gains	773.4853	827.5417	862.3253	844.7356	721.8179	519.8436	337.5416	336.3124	550.3665	692.3947	730.7026	735.8711	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1572.3226	1540.4634	1394.1682	1156.4982	852.6051	548.6839	342.9765	342.3483	608.6969	946.4116	1272.3437	1542.8869	(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													
	594.3350	479.0834	395.6911	224.4691	97.3057	0.0000	0.0000	0.0000	0.0000	188.9886	389.9816	600.4198	(98)
Space heating												2970.2741	(98)
Space heating per m2											(98) / (4) =	27.9161	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3282.0709	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	594.3350	479.0834	395.6911	224.4691	97.3057	0.0000	0.0000	0.0000	0.0000	188.9886	389.9816	600.4198	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	656.7237	529.3739	437.2278	248.0321	107.5201	0.0000	0.0000	0.0000	0.0000	208.8271	430.9189	663.4472	(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													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7416	89.6918	89.5463	89.2293	88.5965	87.3000	87.3000	87.3000	87.3000	89.0661	89.5457	89.7643	(217)
Fuel for water heating, kWh/month													
	198.4426	174.0944	180.9858	159.8218	155.5437	137.8557	129.3705	146.1426	147.2042	166.1819	178.5266	192.6159	(219)
Water heating fuel used												1966.7857	(219)
Annual totals kWh/year													
Space heating fuel - main system												3282.0709	(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)												456.7289	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												4350.1346	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3282.0709	10.2300	335.7558	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1966.7857	10.2300	201.2022	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	456.7289	36.7200	167.7109	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			309.9473	(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	3282.0709	0.2160	708.9273	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1966.7857	0.2160	424.8257	(264)
Space and water heating			1133.7530	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			667.3164	(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	3282.0709	1.2200	4004.1264	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1966.7857	1.2200	2399.4785	(264)
Space and water heating			6403.6050	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	456.7289	3.0700	1402.1578	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			3644.5288	(272)
Primary energy kWh/m2/year			34.2531	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 92

(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	+ 1.1	-£ 86	-195 kg (29.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£86	1.83 kg/m²	A 92	A 94
Total Savings	£86	1.83 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 94

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£195	£214	-£18
Mains gas	£640	£535	£104
Space heating	£466	£466	£0
Water heating	£201	£115	£86
Lighting	£168	£168	£0
Generated (PV)	-£525	-£525	£0
Total cost of fuels	£310	£224	£86
Total cost of uses	£310	£224	£86
Delivered energy	41 kWh/m²	32 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	4 kg/m²	2 kg/m²
Primary energy	34 kWh/m²	24 kWh/m²	10 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Measured/design AP50		4.8300	
Infiltration rate		0.3506	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3243	(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	0.4135	0.4054	0.3972	0.3567	0.3486	0.3081	0.3081	0.3000	0.3243	0.3486	0.3648	0.3810	(22b)
Effective ac	0.5855	0.5822	0.5789	0.5636	0.5608	0.5475	0.5475	0.5450	0.5526	0.5608	0.5665	0.5726	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.1402	52.8390	52.5437	51.1567	50.8972	49.6893	49.6893	49.4656	50.1546	50.8972	51.4222	51.9710	(38)
Heat transfer coeff	120.8313	120.5300	120.2347	118.8478	118.5883	117.3803	117.3803	117.1566	117.8456	118.5883	119.1132	119.6621	(39)
Average = Sum(39)m / 12 =												118.8465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1356	1.1328	1.1300	1.1170	1.1146	1.1032	1.1032	1.1011	1.1076	1.1146	1.1195	1.1246	(40)
HLP (average)												1.1170	(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	2.7914 (42)
Average daily hot water use (litres/day)	100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(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												1.1470	(H8)
Utilisation factor												0.5818	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.4958	(H14)
Volume ratio Veff/V												0.7463	(H15)
Solar storage volume factor												0.9415	(H16)
Solar input												-873.5247	(H17)
Solar input	-25.3305	-42.2693	-71.9894	-96.4800	-119.1929	-117.1856	-115.6370	-101.0326	-79.1288	-54.0357	-30.0456	-21.1973	(63)
								Solar input (sum of months) = Sum(63)m =				-873.5247	(63)
Output from w/h													
	152.7551	113.8792	90.0766	46.1279	18.6134	3.1624	0.0000	26.5498	49.3804	93.9761	129.8173	151.7031	(64)
								Total per year (kWh/year) = Sum(64)m =				876.0414	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(65)

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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	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6547	57.4257	46.7017	35.3562	26.4292	22.3126	24.1096	31.3386	42.0626	53.4081	62.3351	66.4517	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.4308	401.5549	391.1623	369.0378	341.1095	314.8609	297.3252	293.2011	303.5937	325.7182	353.6465	379.8951	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	653.4723	648.0418	622.0958	582.0586	540.9369	504.5668	483.7274	493.3712	516.8138	557.0808	601.6094	635.4176	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	10.6334	0.4600	0.0000	0.7700	20.4889	(74)
South	5.5700	46.7521	0.4600	0.0000	0.7700	92.2369	(78)
West	2.8800	19.6403	0.4600	0.0000	0.7700	20.0350	(80)

Solar gains	132.7608	229.4082	323.5032	418.4870	485.9597	490.3158	469.4197	417.6829	356.0738	256.0474	159.5891	113.2575	(83)
Total gains	786.2330	877.4500	945.5990	1000.5456	1026.8966	994.8825	953.1471	911.0542	872.8875	813.1281	761.1985	748.6751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8690	35.9586	36.0469	36.4676	36.5474	36.9235	36.9235	36.9940	36.7777	36.5474	36.3863	36.2194	
alpha	3.3913	3.3972	3.4031	3.4312	3.4365	3.4616	3.4616	3.4663	3.4518	3.4365	3.4258	3.4146	
util living area													
	0.9746	0.9619	0.9388	0.8904	0.8014	0.6572	0.5100	0.5482	0.7471	0.9034	0.9610	0.9782	(86)
MIT	19.3525	19.5555	19.8719	20.2761	20.6294	20.8707	20.9597	20.9476	20.7865	20.3397	19.7782	19.3127	(87)
Th 2	19.9718	19.9741	19.9764	19.9870	19.9890	19.9982	19.9982	19.9999	19.9947	19.9890	19.9850	19.9808	(88)
util rest of house													
	0.9697	0.9545	0.9265	0.8672	0.7574	0.5809	0.4063	0.4451	0.6801	0.8782	0.9522	0.9739	(89)
MIT 2	17.7908	18.0846	18.5394	19.1150	19.5910	19.8899	19.9756	19.9684	19.7984	19.2147	18.4166	17.7392	(90)
Living area fraction									fLA = Living area / (4) =			0.1941	(91)
MIT	18.0939	18.3700	18.7980	19.3404	19.7925	20.0802	20.1666	20.1584	19.9901	19.4330	18.6808	18.0446	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9439	18.2200	18.6480	19.1904	19.6425	19.9302	20.0166	20.0084	19.8401	19.2830	18.5308	17.8946	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9558	0.9374	0.9058	0.8450	0.7400	0.5752	0.4083	0.4461	0.6684	0.8561	0.9349	0.9614	(94)
Useful gains	751.4985	822.4954	856.5455	845.4331	759.9381	572.3031	389.1911	406.3949	583.4028	696.1149	711.6319	719.7418	(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	1648.6108	1605.4642	1460.6132	1222.9886	941.8930	625.6618	401.0445	422.7509	676.4513	1029.7030	1361.5616	1638.7194	(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	667.4516	526.1551	449.4263	271.8400	135.3745	0.0000	0.0000	0.0000	0.0000	248.1896	467.9494	683.7194	(98)
Space heating												3450.1058	(98)
Space heating per m2											(98) / (4) =	32.4258	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3812.2716	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	667.4516	526.1551	449.4263	271.8400	135.3745	0.0000	0.0000	0.0000	0.0000	248.1896	467.9494	683.7194	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	737.5156	581.3868	496.6037	300.3756	149.5850	0.0000	0.0000	0.0000	0.0000	274.2426	517.0712	755.4910	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	152.7551	113.8792	90.0766	46.1279	18.6134	3.1624	0.0000	26.5498	49.3804	93.9761	129.8173	151.7031	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8864	89.9136	89.9495	90.0213	90.1008	87.3000	87.3000	87.3000	87.3000	89.5980	89.7853	89.9016	(217)
Fuel for water heating, kWh/month	169.9424	126.6540	100.1413	51.2411	20.6584	3.6224	0.0000	30.4122	56.5641	104.8864	144.5864	168.7435	(219)
Water heating fuel used												977.4523	(219)
Annual totals kWh/year													
Space heating fuel - main system												3812.2716	(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)												456.7289	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1080 * 1.00) =										-1278.1572		-1278.1572	(233)
Total delivered energy for all uses												4093.2957	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3812.2716	3.4800	132.6671	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	977.4523	3.4800	34.0153	(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	456.7289	13.1900	60.2425	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1278.1572	13.1900	-168.5889	(252)
Total energy cost			194.8235	(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] =	0.5405	(257)
SAP value	92.4606	
SAP rating (Section 12)	92	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3812.2716	0.2160	823.4507	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	977.4523	0.2160	211.1297	(264)
Space and water heating			1034.5804	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Energy saving/generation technologies				
PV Unit	-1278.1572	0.5190	-663.3636	(269)
Total kg/year			673.1341	(272)
CO2 emissions per m2			6.3300	(273)
EI value			94.0423	
EI rating			94	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.2000 (1b)	x	2.5400 (2b)	=	135.1280	(1b) - (3b)
First floor	53.2000 (1c)	x	2.6300 (2c)	=	139.9160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	106.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	275.0440	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1091	(8)
Pressure test			Yes	
Measured/design AP50			4.8300	
Infiltration rate			0.3506	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3243	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3405	0.3162	0.3243	0.3081	0.3081	0.3000	0.2919	0.2837	0.2756	0.3000	0.2837	0.3000	(22b)
Effective ac	0.5580	0.5500	0.5526	0.5475	0.5475	0.5450	0.5426	0.5403	0.5380	0.5450	0.5403	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1500	1.4000	3.0100			(26a)
Window (Uw = 1.30)			13.8900	1.2357	17.1644			(27)
GF B&B J150 P/A=0.40			53.2000	0.1200	6.3840	75.0000	3990.0000	(28a)
EW Brick AAC015	106.7600	18.1700	88.5900	0.2500	22.1475	52.3000	4633.2570	(29a)
Plane Ceiling	53.2000		53.2000	0.1600	8.5120	9.0000	478.8000	(30)
Total net area of external elements Aum(A, m2)			213.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.9869			(33)
E-WM-30			50.3500	0.0000	0.0000	45.0000	2265.7500	(32)
GF Timber			78.0000			9.0000	702.0000	(32c)
1F Timber			113.0000			9.0000	1017.0000	(32c)
GF Masonry			27.6800			39.0000	1079.5200	(32c)
Internal Floor			53.2000			18.0000	957.6000	(32d)
Internal Ceiling			53.2000			9.0000	478.8000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15602.7270 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.6422 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.7041 (36)
Total fabric heat loss	(33) + (36) =	67.6910 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6437	49.9189	50.1546	49.6893	49.6893	49.4656	49.2478	49.0361	48.8302	49.4656	49.0361	49.4656	(38)
Heat transfer coeff	118.3348	117.6100	117.8456	117.3803	117.3803	117.1566	116.9389	116.7271	116.5213	117.1566	116.7271	117.1566	(39)
Average = Sum(39)m / 12 =												117.2446	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1122	1.1054	1.1076	1.1032	1.1032	1.1011	1.0990	1.0971	1.0951	1.1011	1.0971	1.1011	(40)
HLP (average)												1.1019	(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		2.7914 (42)
Average daily hot water use (litres/day)		100.4958 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.5454	106.5255	102.5057	98.4859	94.4660	90.4462	90.4462	94.4660	98.4859	102.5057	106.5255	110.5454	(44)

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

Energy conte	163.9356	143.3791	147.9544	128.9902	123.7692	106.8034	98.9690	113.5684	114.9248	133.9338	146.1992	158.7628	(45)
Energy content (annual)										Total = Sum(45)m =		1581.1899	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5903	21.5069	22.1932	19.3485	18.5654	16.0205	14.8454	17.0353	17.2387	20.0901	21.9299	23.8144	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1500	12.7694	14.1117	13.6177	14.0372	13.5446	13.9714	14.0140	13.5844	14.0780	13.6637	14.1376	(61)
Total heat required for water heating calculated for each month													
	178.0856	156.1485	162.0660	142.6079	137.8063	120.3480	112.9404	127.5825	128.5092	148.0118	159.8629	172.9004	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2836	(H8)
Utilisation factor												0.5411	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.4958	(H14)
Volume ratio Veff/V												0.7463	(H15)
Solar storage volume factor												0.9415	(H16)
Solar input												-909.2628	(H17)
Solar input	-29.6624	-42.1780	-72.4938	-97.8109	-114.8848	-122.7151	-120.1344	-107.5239	-84.1838	-58.2018	-35.0827	-24.3911	(63)
								Solar input (sum of months) = Sum(63)m =				-909.2628	(63)
Output from w/h													
	148.4232	113.9705	89.5722	44.7970	22.9215	0.0000	0.0000	20.0585	44.3254	89.8100	124.7801	148.5093	(64)
								Total per year (kWh/year) = Sum(64)m =				847.1678	(64)
Heat gains from water heating, kWh/month													
	58.0461	50.8659	52.7227	46.2937	44.6625	38.8983	36.4001	41.2650	41.6086	48.0525	52.0271	56.3230	(65)

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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	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	167.4841	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6547	57.4257	46.7017	35.3562	26.4292	22.3126	24.1096	31.3386	42.0626	53.4081	62.3351	66.4517	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	397.4308	401.5549	391.1623	369.0378	341.1095	314.8609	297.3252	293.2011	303.5937	325.7182	353.6465	379.8951	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	54.5398	(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)													
	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	-111.6560	(71)
Water heating gains (Table 5)													
	78.0189	75.6933	70.8639	64.2968	60.0303	54.0254	48.9248	55.4637	57.7897	64.5867	72.2599	75.7030	(72)
Total internal gains													
	653.4723	648.0418	622.0958	582.0586	540.9369	504.5668	483.7274	493.3712	516.8138	557.0808	601.6094	635.4176	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.4400	13.4839	0.4600	0.0000	0.7700	25.9814	(74)
South	5.5700	56.7559	0.4600	0.0000	0.7700	111.9733	(78)
West	2.8800	25.1925	0.4600	0.0000	0.7700	25.6988	(80)

Solar gains	163.6535	241.0425	344.2535	451.5017	501.3434	550.7959	522.6615	474.2923	401.3496	290.6579	196.1431	137.2146	(83)
Total gains	817.1258	889.0843	966.3494	1033.5604	1042.2802	1055.3627	1006.3890	967.6635	918.1634	847.7387	797.7524	772.6322	(84)

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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	36.6257	36.8514	36.7777	36.9235	36.9235	36.9940	37.0629	37.1301	37.1957	36.9940	37.1301	36.9940	
alpha	3.4417	3.4568	3.4518	3.4616	3.4616	3.4663	3.4709	3.4753	3.4797	3.4663	3.4753	3.4663	
util living area													
	0.9683	0.9569	0.9280	0.8664	0.7586	0.5781	0.4368	0.4517	0.6833	0.8711	0.9473	0.9722	(86)
MIT	19.5242	19.6784	20.0011	20.3966	20.7251	20.9234	20.9781	20.9758	20.8579	20.4868	19.9711	19.5073	(87)
Th 2	19.9909	19.9965	19.9947	19.9982	19.9982	19.9999	20.0016	20.0032	20.0048	19.9999	20.0032	19.9999	(88)
util rest of house													
	0.9620	0.9486	0.9136	0.8386	0.7063	0.4941	0.3320	0.3442	0.6063	0.8379	0.9352	0.9667	(89)
MIT 2	18.0512	18.2759	18.7347	19.2873	19.7182	19.9431	19.9915	19.9919	19.8851	19.4214	18.7043	18.0334	(90)
Living area fraction										fLA = Living area / (4) =		0.1941	(91)
MIT	18.3371	18.5481	18.9805	19.5026	19.9136	20.1333	20.1830	20.1829	20.0739	19.6282	18.9502	18.3194	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1871	18.3981	18.8305	19.3526	19.7636	19.9833	20.0330	20.0329	19.9239	19.4782	18.8002	18.1694	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9308	0.8924	0.8173	0.6925	0.4926	0.3354	0.3476	0.5994	0.8168	0.9160	0.9524	(94)
Useful gains	773.4853	827.5417	862.3253	844.7356	721.8179	519.8436	337.5416	336.3124	550.3665	692.3947	730.7026	735.8711	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1572.3226	1540.4634	1394.1682	1156.4982	852.6051	548.6839	342.9765	342.3483	608.6969	946.4116	1272.3437	1542.8869	(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	594.3350	479.0834	395.6911	224.4691	97.3057	0.0000	0.0000	0.0000	0.0000	188.9886	389.9816	600.4198	(98)
Space heating												2970.2741	(98)
Space heating per m2											(98) / (4) =	27.9161	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3282.0709	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	594.3350	479.0834	395.6911	224.4691	97.3057	0.0000	0.0000	0.0000	0.0000	188.9886	389.9816	600.4198	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	656.7237	529.3739	437.2278	248.0321	107.5201	0.0000	0.0000	0.0000	0.0000	208.8271	430.9189	663.4472	(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	148.4232	113.9705	89.5722	44.7970	22.9215	0.0000	0.0000	20.0585	44.3254	89.8100	124.7801	148.5093	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8419	89.8670	89.8918	89.9515	89.8719	87.3000	87.3000	87.3000	87.3000	89.4439	89.7030	89.8469	(217)
Fuel for water heating, kWh/month	165.2048	126.8214	99.6445	49.8013	25.5047	0.0000	0.0000	22.9766	50.7737	100.4093	139.1037	165.2915	(219)
Water heating fuel used												945.5313	(219)
Annual totals kWh/year													
Space heating fuel - main system												3282.0709	(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)												456.7289	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1208 * 1.00) =										-1430.4508		-1430.4508	(233)
Total delivered energy for all uses												3378.8803	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3282.0709	10.2300	335.7558	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	945.5313	10.2300	96.7279	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	456.7289	36.7200	167.7109	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1430.4508	36.7200	-525.2615	(252)
Total energy cost			223.8330	(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	3282.0709	0.2160	708.9273	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	945.5313	0.2160	204.2348	(264)
Space and water heating			913.1621	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7289	0.5190	237.0423	(268)
Energy saving/generation technologies				

PV Unit	-1430.4508	0.5190	-742.4040	(269)
Total kg/year			472.6754	(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	3282.0709	1.2200	4004.1264	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	945.5313	1.2200	1153.5482	(264)
Space and water heating			5157.6747	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	456.7289	3.0700	1402.1578	(268)
Energy saving/generation technologies				
PV Unit	-1430.4508	3.0700	-4391.4840	(269)
Primary energy kWh/year			2552.0985	(272)
Primary energy kWh/m2/year			23.9859	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	146.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		363.06 (P1)
Transmission heat loss coefficient		67.69 (37)
Summer heat loss coefficient		430.75 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.4400	87.1704	0.4600	0.0000	0.9000	196.3218
South	5.5700	118.5567	0.4600	0.0000	0.9000	273.3893
West	2.8800	125.2818	0.4600	0.0000	0.9000	149.3760
total:						619.0871

	Jun	Jul	Aug	
Solar gains	663	619	560	(P4)
Internal gains	502	481	490	
Total summer gains	1165	1100	1050	(P5)
Summer gain/loss ratio	2.70	2.55	2.44	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 146.6)	0.97	0.97	0.97	
Threshold temperature	19.08	20.83	20.71	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-597	**Issued on Date**	20/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Dawlish-As-DET
Property	2, House Sparrow Way , Botley, Southampton, SO32 2UR		

SAP Rating	90 B	**DER**	12.08	**TER**	19.28
Environmental	90 B	**% DER<TER**	37.34		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.81	**TFEE**	62.52
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.34		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 97 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) 19.28 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.08 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)62.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)54.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.70 (measured in this dwelling)
Maximum 10.0 OK

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

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.95 m², No overhang
Windows facing South East: 1.31 m², No overhang
Windows facing South: 1.03 m², No overhang
Windows facing South West: 5.25 m², No overhang
Windows facing West: 1.03 m², No overhang
Windows facing North West: 6.71 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.4341	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4341	(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	0.5535	0.5426	0.5318	0.4775	0.4666	0.4124	0.4124	0.4015	0.4341	0.4666	0.4884	0.5101	(22b)
Effective ac	0.6532	0.6472	0.6414	0.6140	0.6089	0.5850	0.5850	0.5806	0.5942	0.6089	0.6192	0.6301	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.1319	53.6390	53.1559	50.8866	50.4620	48.4855	48.4855	48.1195	49.2468	50.4620	51.3209	52.2189	(38)
Heat transfer coeff	139.5057	139.0128	138.5296	136.2603	135.8357	133.8592	133.8592	133.4932	134.6205	135.8357	136.6946	137.5926	(39)
Average = Sum(39)m / 12 =												136.2583	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4278	1.4229	1.3996	1.3952	1.3749	1.3749	1.3711	1.3827	1.3952	1.4040	1.4132	(40)
HLP (average)												1.3995	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	417.8424	415.6611	400.6028	376.1820	351.1829	327.2146	311.7142	318.0311	330.6319	355.2780	383.6216	405.0753	(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	
Northeast	2.6200	11.2829	0.4600	0.0000	0.7700	10.4706	(75)
Southeast	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(77)
South	1.0300	46.7521	0.4600	0.0000	0.7700	17.0564	(78)
Southwest	5.2500	36.7938	0.4600	0.0000	0.7700	68.4200	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	160.3087	290.5628	443.4668	625.4895	769.3059	793.7835	752.8037	641.0368	505.8592	333.5664	195.2132	135.1125	(83)
Total gains	578.1510	706.2239	844.0696	1001.6716	1120.4888	1120.9981	1064.5178	959.0680	836.4911	688.8444	578.8348	540.1878	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7682	34.8915	35.0132	35.5963	35.7076	36.2348	36.2348	36.3342	36.0299	35.7076	35.4832	35.2517	
alpha	3.3179	3.3261	3.3342	3.3731	3.3805	3.4157	3.4157	3.4223	3.4020	3.3805	3.3655	3.3501	
util living area													
	0.9926	0.9851	0.9670	0.9176	0.8156	0.6607	0.5180	0.5821	0.8115	0.9528	0.9872	0.9941	(86)
MIT	18.9547	19.2014	19.6079	20.1438	20.5896	20.8631	20.9556	20.9341	20.7055	20.1116	19.4425	18.9239	(87)
Th 2	19.7382	19.7421	19.7459	19.7637	19.7670	19.7826	19.7826	19.7855	19.7766	19.7670	19.7603	19.7532	(88)
util rest of house													
	0.9907	0.9812	0.9580	0.8942	0.7630	0.5668	0.3895	0.4516	0.7367	0.9347	0.9832	0.9926	(89)
MIT 2	17.0409	17.4016	17.9910	18.7590	19.3527	19.6818	19.7629	19.7529	19.5214	18.7325	17.7660	17.0050	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.4289	17.7665	18.3188	19.0398	19.6035	19.9213	20.0048	19.9924	19.7615	19.0121	18.1059	17.3941	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2789	17.6165	18.1688	18.8898	19.4535	19.7713	19.8548	19.8424	19.6115	18.8621	17.9559	17.2441	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9845	0.9711	0.9418	0.8729	0.7473	0.5658	0.3976	0.4582	0.7245	0.9159	0.9739	0.9874	(94)
Useful gains	569.1732	685.7902	794.9152	874.3471	837.2972	634.3112	423.2694	439.4612	606.0121	630.9280	563.7347	533.3892	(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													
	1810.6363	1767.7618	1616.4772	1361.2107	1053.2053	692.2285	435.6808	459.5345	741.9588	1122.2934	1483.9412	1794.7704	(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													
	923.6485	727.0849	611.2421	350.5417	160.6356	0.0000	0.0000	0.0000	0.0000	365.5759	662.5487	938.4676	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			4739.7450 (98)
Space heating per m2	(98) / (4) =		48.6827 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5237.2873	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	923.6485	727.0849	611.2421	350.5417	160.6356	0.0000	0.0000	0.0000	0.0000	365.5759	662.5487	938.4676	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1020.6061	803.4087	675.4057	387.3389	177.4979	0.0000	0.0000	0.0000	0.0000	403.9512	732.0980	1036.9808	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9745	89.9254	89.8192	89.5620	89.0070	87.3000	87.3000	87.3000	87.3000	89.5651	89.8684	89.9941	(217)
Fuel for water heating, kWh/month													
	194.5754	170.7076	177.4040	156.5713	152.2616	135.5997	127.2799	143.7432	144.7757	162.5037	174.8913	188.8771	(219)
Water heating fuel used												1929.1903	(219)
Annual totals kWh/year													
Space heating fuel - main system												5237.2873	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												6449.7097	(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	5237.2873	0.2160	1131.2541	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.1903	0.2160	416.7051	(264)
Space and water heating			1547.9592	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total CO2, kg/year			1175.9566	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.0800	(273)

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

DER		12.0800	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		29.3084	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.3084	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3695	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.6766	47.2549	43.7846	45.2441	47.2549	47.6766	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
								Total per year (kWh/year) = Sum(64)m =				2130.2265	(64)
Heat gains from water heating, kWh/month													
	66.2474	58.3050	61.0313	54.0209	52.2113	45.8062	43.6140	48.8819	49.4300	56.4550	60.0474	64.5591	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(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	
Northeast	5.6200	11.2829	0.6300	0.7000	0.7700	19.3790	(75)
Southeast	1.2400	36.7938	0.6300	0.7000	0.7700	13.9434	(77)
South	0.9700	46.7521	0.6300	0.7000	0.7700	13.8594	(78)
Southwest	4.9500	36.7938	0.6300	0.7000	0.7700	55.6611	(79)
West	0.9700	19.6403	0.6300	0.7000	0.7700	5.8223	(80)
Northwest	6.3400	11.2829	0.6300	0.7000	0.7700	21.8617	(81)

Solar gains	130.5268	236.5964	361.1373	509.4229	626.5981	646.5538	613.1673	522.1027	411.9650	271.6226	158.9493	110.0099	(83)
Total gains	560.8193	664.7029	774.1809	897.4781	988.9787	984.2986	935.4219	851.3449	754.4894	639.3607	555.0284	527.5417	(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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9983	0.9959	0.9888	0.9620	0.8836	0.7279	0.5663	0.6345	0.8730	0.9806	0.9964	0.9987	(86)
MIT	19.5067	19.6791	19.9727	20.3696	20.7153	20.9206	20.9804	20.9678	20.8039	20.3528	19.8607	19.4817	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9976	0.9945	0.9845	0.9467	0.8366	0.6291	0.4297	0.4955	0.8027	0.9701	0.9949	0.9982	(89)
MIT 2	17.8406	18.0943	18.5230	19.0988	19.5618	19.8001	19.8455	19.8415	19.6872	19.0855	18.3694	17.8117	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.1784	18.4156	18.8170	19.3565	19.7957	20.0273	20.0756	20.0699	19.9136	19.3425	18.6718	18.1503	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1784	18.4156	18.8170	19.3565	19.7957	20.0273	20.0756	20.0699	19.9136	19.3425	18.6718	18.1503	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9918	0.9793	0.9384	0.8344	0.6456	0.4575	0.5235	0.8076	0.9637	0.9926	0.9972	(94)
Useful gains	558.7259	659.2773	758.1220	842.1623	825.1864	635.4908	427.9403	445.6655	609.2971	616.1431	550.8959	526.0408	(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													
	1793.3201	1741.6087	1582.8436	1326.5689	1024.5712	679.0933	434.8896	458.2245	730.6379	1106.4280	1471.6962	1783.2702	(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													
	918.5381	727.3267	613.5929	348.7727	148.3423	0.0000	0.0000	0.0000	0.0000	364.7720	662.9763	935.3787	(98)
Space heating												4719.6996	(98)
Space heating per m2											(98) / (4) =	48.4768	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5053.2115	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	918.5381	727.3267	613.5929	348.7727	148.3423	0.0000	0.0000	0.0000	0.0000	364.7720	662.9763	935.3787	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	983.4455	778.7224	656.9517	373.4184	158.8247	0.0000	0.0000	0.0000	0.0000	390.5481	709.8247	1001.4761	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3178	88.1350	87.7266	86.7636	84.7285	80.3000	80.3000	80.3000	80.3000	86.7618	87.9086	88.3871	(217)
Fuel for water heating, kWh/month													
	239.9111	211.9180	223.6454	200.8888	199.1673	185.0896	177.3299	197.6813	199.8645	210.2693	219.3525	233.9783	(219)
Water heating fuel used												2499.0959	(219)
Annual totals kWh/year													
Space heating fuel - main system												5053.2115	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												8025.6685	(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	5053.2115	0.2160	1091.4937	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2499.0959	0.2160	539.8047	(264)
Space and water heating			1631.2984	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1876.9728	(272)
Emissions per m2 for space and water heating			16.7553	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.7553 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			19.2800	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.3545	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3545	(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	0.4519	0.4431	0.4342	0.3899	0.3810	0.3367	0.3367	0.3279	0.3545	0.3810	0.3988	0.4165	(22b)
Effective ac	0.6021	0.5982	0.5943	0.5760	0.5726	0.5567	0.5567	0.5537	0.5628	0.5726	0.5795	0.5867	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	85.3737 (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	49.9017	49.5731	49.2510	47.7379	47.4548	46.1370	46.1370	45.8929	46.6446	47.4548	48.0275	48.6262	(38)
Heat transfer coeff	135.2755	134.9468	134.6247	133.1116	132.8285	131.5107	131.5107	131.2667	132.0183	132.8285	133.4012	133.9999	(39)
Average = Sum(39)m / 12 =												133.1103	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3894	1.3861	1.3828	1.3672	1.3643	1.3508	1.3508	1.3483	1.3560	1.3643	1.3702	1.3763	(40)
HLP (average)												1.3672	(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		2.7137 (42)
Average daily hot water use (litres/day)		98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.1344	382.7796	369.4377	347.3539	323.8733	302.0408	288.3524	292.3441	304.1161	326.3439	351.9604	372.1904	(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	
Northeast	2.6200	11.2829	0.4600	0.0000	0.7700	10.4706	(75)
Southeast	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(77)
South	1.0300	46.7521	0.4600	0.0000	0.7700	17.0564	(78)
Southwest	5.2500	36.7938	0.4600	0.0000	0.7700	68.4200	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	160.3087	290.5628	443.4668	625.4895	769.3059	793.7835	752.8037	641.0368	505.8592	333.5664	195.2132	135.1125	(83)
Total gains	544.4430	673.3424	812.9045	972.8434	1093.1792	1095.8244	1041.1561	933.3809	809.9753	659.9103	547.1736	507.3029	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8555	35.9428	36.0288	36.4383	36.5160	36.8819	36.8819	36.9505	36.7401	36.5160	36.3592	36.1968	
alpha	3.3904	3.3962	3.4019	3.4292	3.4344	3.4588	3.4588	3.4634	3.4493	3.4344	3.4239	3.4131	
util living area													
	0.9939	0.9870	0.9697	0.9213	0.8193	0.6647	0.5209	0.5879	0.8184	0.9571	0.9892	0.9952	(86)
MIT	18.9795	19.2251	19.6293	20.1556	20.5983	20.8656	20.9569	20.9347	20.7061	20.1132	19.4491	18.9402	(87)
Th 2	19.7714	19.7740	19.7766	19.7886	19.7908	19.8013	19.8013	19.8032	19.7972	19.7908	19.7863	19.7815	(88)
util rest of house													
	0.9923	0.9836	0.9614	0.8989	0.7678	0.5718	0.3937	0.4584	0.7457	0.9406	0.9857	0.9939	(89)
MIT 2	17.9454	18.1911	18.5919	19.1091	19.5125	19.7332	19.7881	19.7808	19.6217	19.0811	18.4244	17.9135	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.1550	18.4008	18.8022	19.3213	19.7327	19.9628	20.0250	20.0148	19.8416	19.2903	18.6322	18.1217	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1550	18.4008	18.8022	19.3213	19.7327	19.9628	20.0250	20.0148	19.8416	19.2903	18.6322	18.1217	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9783	0.9527	0.8883	0.7650	0.5855	0.4188	0.4831	0.7489	0.9315	0.9811	0.9914	(94)
Useful gains	538.5732	658.7126	774.4600	864.2079	836.2826	641.5997	435.9967	450.9501	606.5705	614.7008	536.8324	502.9517	(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													
	1874.2470	1821.8836	1656.1845	1387.1946	1066.9659	705.2664	450.4300	474.5006	757.9947	1154.3229	1538.4067	1865.5037	(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													
	993.7413	781.6509	656.0031	376.5505	171.6283	0.0000	0.0000	0.0000	0.0000	401.4788	721.1335	1013.7387	(98)
Space heating												5115.9251	(98)
Space heating per m2											(98) / (4) =	52.5465	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1236.2007	973.1792	997.6267	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8174	0.8764	0.8400	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1010.5266	852.9365	837.9944	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1384.3677	1318.2417	1194.0786	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	269.1656	346.1871	264.9267	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												880.2793	(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	67.2914	86.5468	66.2317	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												220.0698	(107)
Space cooling per m2												2.2604	(108)
Energy for space heating												52.5465	(99)
Energy for space cooling												2.2604	(108)
Total												54.8069	(109)
Dwelling Fabric Energy Efficiency (DFEE)												54.8	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.3682	(36)
Total fabric heat loss (33) + (36) =	78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(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	
Northeast	5.6200	11.2829	0.6300	0.7000	0.7700	19.3790	(75)
Southeast	1.2400	36.7938	0.6300	0.7000	0.7700	13.9434	(77)
South	0.9700	46.7521	0.6300	0.7000	0.7700	13.8594	(78)
Southwest	4.9500	36.7938	0.6300	0.7000	0.7700	55.6611	(79)
West	0.9700	19.6403	0.6300	0.7000	0.7700	5.8223	(80)
Northwest	6.3400	11.2829	0.6300	0.7000	0.7700	21.8617	(81)

Solar gains	130.5268	236.5964	361.1373	509.4229	626.5981	646.5538	613.1673	522.1027	411.9650	271.6226	158.9493	110.0099	(83)
Total gains	514.7403	619.4464	730.6322	856.8201	950.5038	948.6219	901.5493	814.4851	716.1326	598.0318	510.9860	482.2816	(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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9988	0.9969	0.9910	0.9677	0.8956	0.7457	0.5845	0.6568	0.8897	0.9849	0.9975	0.9991	(86)
MIT	19.4639	19.6375	19.9340	20.3375	20.6942	20.9121	20.9777	20.9629	20.7837	20.3172	19.8200	19.4395	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9983	0.9958	0.9876	0.9543	0.8516	0.6477	0.4450	0.5159	0.8246	0.9765	0.9964	0.9988	(89)
MIT 2	18.4258	18.6012	18.8981	19.3034	19.6335	19.8122	19.8470	19.8441	19.7239	19.2911	18.7942	18.4101	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6363	18.8113	19.1081	19.5131	19.8486	20.0352	20.0762	20.0709	19.9388	19.4991	19.0022	18.6188	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6363	18.8113	19.1081	19.5131	19.8486	20.0352	20.0762	20.0709	19.9388	19.4991	19.0022	18.6188	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9945	0.9847	0.9494	0.8519	0.6650	0.4736	0.5447	0.8309	0.9731	0.9952	0.9983	(94)
Useful gains	513.5535	616.0310	719.4199	813.5030	809.7745	630.8315	426.9710	443.6154	595.0039	581.9283	508.5458	481.4566	(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													
	1852.4846	1792.6036	1620.2629	1346.4357	1031.2672	680.0860	434.9695	458.3566	733.8078	1126.2569	1513.7232	1843.1665	(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													
	996.1647	790.6568	670.2272	383.7116	164.7906	0.0000	0.0000	0.0000	0.0000	404.9805	723.7277	1013.1121	(98)
Space heating												5147.3712	(98)
Space heating per m2											(98) / (4) =	52.8695	(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	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8337	0.8991	0.8624	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	980.5979	832.4649	818.3611	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1212.3492	1155.1041	1055.1605	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	166.8609	240.0435	176.1788	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												583.0833	(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	41.7152	60.0109	44.0447	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												145.7708	(107)
Space cooling per m2												1.4972	(108)
Energy for space heating												52.8695	(99)
Energy for space cooling												1.4972	(108)
Total												54.3667	(109)
Target Fabric Energy Efficiency (TFEE)												62.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.4341	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4341	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4558	0.4232	0.4341	0.4124	0.4124	0.4015	0.3907	0.3798	0.3690	0.4015	0.3798	0.4015	(22b)
Effective ac	0.6039	0.5896	0.5942	0.5850	0.5850	0.5806	0.5763	0.5721	0.5681	0.5806	0.5721	0.5806	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.0472	48.8613	49.2468	48.4855	48.4855	48.1195	47.7632	47.4167	47.0800	48.1195	47.4167	48.1195	(38)
Heat transfer coeff	135.4209	134.2350	134.6205	133.8592	133.8592	133.4932	133.1369	132.7904	132.4537	133.4932	132.7904	133.4932	(39)
Average = Sum(39)m / 12 =												133.6371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3909	1.3787	1.3827	1.3749	1.3749	1.3711	1.3675	1.3639	1.3605	1.3711	1.3639	1.3711	(40)
HLP (average)												1.3726	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
RHI water heating demand												1718	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	
Northeast	2.6200	14.6176	0.4600	0.0000	0.7700	13.5652	(75)
Southeast	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(77)
South	1.0300	56.7559	0.4600	0.0000	0.7700	20.7060	(78)
Southwest	5.2500	45.1778	0.4600	0.0000	0.7700	84.0104	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(81)
Northeast	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(75)

Solar gains	200.4180	310.5132	480.9626	686.5536	804.4138	901.8777	848.5533	739.4812	580.9975	385.5546	243.5487	165.8678	(83)
Total gains	820.6548	926.0868	1072.6400	1240.9845	1320.4684	1383.6202	1310.2562	1209.9830	1072.9380	914.9670	814.6817	768.7984	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8170	36.1334	36.0299	36.2348	36.2348	36.3342	36.4314	36.5265	36.6193	36.3342	36.5265	36.3342	
alpha	3.3878	3.4089	3.4020	3.4157	3.4157	3.4223	3.4288	3.4351	3.4413	3.4223	3.4351	3.4223	
util living area													
	0.9769	0.9651	0.9309	0.8487	0.7129	0.5155	0.3861	0.4144	0.6695	0.8834	0.9593	0.9804	(86)
MIT	19.3792	19.5691	19.9562	20.4264	20.7682	20.9438	20.9842	20.9806	20.8626	20.4412	19.8669	19.3678	(87)
Th 2	19.7703	19.7797	19.7766	19.7826	19.7826	19.7855	19.7884	19.7911	19.7938	19.7855	19.7911	19.7855	(88)
util rest of house													
	0.9711	0.9565	0.9137	0.8118	0.6454	0.4184	0.2708	0.2922	0.5746	0.8448	0.9474	0.9754	(89)
MIT 2	17.6750	17.9531	18.5002	19.1450	19.5708	19.7513	19.7831	19.7845	19.6930	19.1863	18.3927	17.6687	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.0205	18.2808	18.7954	19.4048	19.8135	19.9930	20.0266	20.0270	19.9301	19.4407	18.6916	18.0132	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8705	18.1308	18.6454	19.2548	19.6635	19.8430	19.8766	19.8770	19.7801	19.2907	18.5416	17.8632	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9581	0.9404	0.8930	0.7928	0.6381	0.4233	0.2795	0.3012	0.5734	0.8250	0.9301	0.9637	(94)
Useful gains	786.2366	870.8636	957.9062	983.8496	842.5499	585.6747	366.1934	364.4066	615.2563	754.8463	757.7054	740.8587	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1756.4818	1722.3387	1567.7064	1305.7703	958.9063	606.4651	369.6705	368.7563	672.8785	1053.3595	1413.0996	1717.1512	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	721.8624	572.1912	453.6914	231.7829	86.5691	0.0000	0.0000	0.0000	0.0000	222.0938	471.8838	726.3617 (98)
Space heating												3486.4364 (98)
RHI space heating demand												3486 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.4341	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4341	(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	0.5535	0.5426	0.5318	0.4775	0.4666	0.4124	0.4124	0.4015	0.4341	0.4666	0.4884	0.5101	(22b)
Effective ac	0.6532	0.6472	0.6414	0.6140	0.6089	0.5850	0.5850	0.5806	0.5942	0.6089	0.6192	0.6301	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.1319	53.6390	53.1559	50.8866	50.4620	48.4855	48.4855	48.1195	49.2468	50.4620	51.3209	52.2189	(38)
Heat transfer coeff	139.5057	139.0128	138.5296	136.2603	135.8357	133.8592	133.8592	133.4932	134.6205	135.8357	136.6946	137.5926	(39)
Average = Sum(39)m / 12 =												136.2583	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4278	1.4229	1.3996	1.3952	1.3749	1.3749	1.3711	1.3827	1.3952	1.4040	1.4132	(40)
HLP (average)												1.3995	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	
Northeast	2.6200	11.2829	0.4600	0.0000	0.7700	10.4706	(75)
Southeast	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(77)
South	1.0300	46.7521	0.4600	0.0000	0.7700	17.0564	(78)
Southwest	5.2500	36.7938	0.4600	0.0000	0.7700	68.4200	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	160.3087	290.5628	443.4668	625.4895	769.3059	793.7835	752.8037	641.0368	505.8592	333.5664	195.2132	135.1125	(83)
Total gains	780.5455	906.1364	1035.1442	1179.9204	1285.3606	1275.5260	1214.5066	1111.5386	997.7997	862.9788	766.3462	738.0431	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7682	34.8915	35.0132	35.5963	35.7076	36.2348	36.2348	36.3342	36.0299	35.7076	35.4832	35.2517	
alpha	3.3179	3.3261	3.3342	3.3731	3.3805	3.4157	3.4157	3.4223	3.4020	3.3805	3.3655	3.3501	
util living area													
	0.9822	0.9700	0.9437	0.8803	0.7650	0.6032	0.4630	0.5175	0.7444	0.9169	0.9714	0.9850	(86)
MIT	19.1792	19.4150	19.7954	20.2841	20.6711	20.8970	20.9685	20.9541	20.7808	20.2700	19.6452	19.1462	(87)
Th 2	19.7382	19.7421	19.7459	19.7637	19.7670	19.7826	19.7826	19.7855	19.7766	19.7670	19.7603	19.7532	(88)
util rest of house													
	0.9777	0.9626	0.9295	0.8499	0.7067	0.5106	0.3444	0.3953	0.6611	0.8888	0.9630	0.9813	(89)
MIT 2	17.3658	17.7079	18.2535	18.9431	19.4447	19.7094	19.7692	19.7638	19.5963	18.9444	18.0560	17.3273	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.7335	18.0540	18.5661	19.2150	19.6933	19.9502	20.0123	20.0051	19.8365	19.2132	18.3782	17.6961	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5835	17.9040	18.4161	19.0650	19.5433	19.8002	19.8623	19.8551	19.6865	19.0632	18.2282	17.5461	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9663	0.9472	0.9093	0.8288	0.6947	0.5121	0.3525	0.4027	0.6541	0.8678	0.9480	0.9712	(94)
Useful gains	754.2701	858.2840	941.2845	977.9670	892.9432	653.1736	428.1002	447.6614	652.6309	748.8865	726.5051	716.8126	(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													
	1853.1209	1807.7225	1650.7340	1385.0797	1065.4039	696.0887	436.6924	461.2375	752.0563	1149.6006	1521.1681	1836.3232	(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													
	817.5450	638.0227	527.8304	293.1212	128.3108	0.0000	0.0000	0.0000	0.0000	298.1313	572.1573	832.9160	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating		4108.0347 (98)
Space heating per m2	(98) / (4) =	42.1943 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		90.5000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		4539.2648 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	817.5450	638.0227	527.8304	293.1212	128.3108	0.0000	0.0000	0.0000	0.0000	298.1313	572.1573	832.9160	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	903.3647	704.9975	583.2380	323.8908	141.7798	0.0000	0.0000	0.0000	0.0000	329.4269	632.2181	920.3491	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9187	89.8612	89.7373	89.4391	88.8275	87.3000	87.3000	87.3000	87.3000	89.4247	89.7907	89.9412	(217)
Fuel for water heating, kWh/month													
	194.6962	170.8296	177.5660	156.7863	152.5693	135.5997	127.2799	143.7432	144.7757	162.7588	175.0425	188.9882	(219)
Water heating fuel used												1930.6354	(219)
Annual totals kWh/year													
Space heating fuel - main system												4539.2648	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												5753.1323	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4539.2648	3.4800	157.9664	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1930.6354	3.4800	67.1861	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			250.6108	(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] =	0.7394 (257)
SAP value		89.6858
SAP rating (Section 12)		90 (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	4539.2648	0.2160	980.4812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1930.6354	0.2160	417.0172	(264)
Space and water heating			1397.4984	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			1025.4959	(272)
CO2 emissions per m2			10.5300	(273)
EI value			90.3473	
EI rating			90	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.4341	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4341	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4558	0.4232	0.4341	0.4124	0.4124	0.4015	0.3907	0.3798	0.3690	0.4015	0.3798	0.4015	(22b)
Effective ac	0.6039	0.5896	0.5942	0.5850	0.5850	0.5806	0.5763	0.5721	0.5681	0.5806	0.5721	0.5806	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.0472	48.8613	49.2468	48.4855	48.4855	48.1195	47.7632	47.4167	47.0800	48.1195	47.4167	48.1195	(38)
Heat transfer coeff	135.4209	134.2350	134.6205	133.8592	133.8592	133.4932	133.1369	132.7904	132.4537	133.4932	132.7904	133.4932	(39)
Average = Sum(39)m / 12 =												133.6371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3909	1.3787	1.3827	1.3749	1.3749	1.3711	1.3675	1.3639	1.3605	1.3711	1.3639	1.3711	(40)
HLP (average)												1.3726	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	
Northeast	2.6200	14.6176	0.4600	0.0000	0.7700	13.5652	(75)
Southeast	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(77)
South	1.0300	56.7559	0.4600	0.0000	0.7700	20.7060	(78)
Southwest	5.2500	45.1778	0.4600	0.0000	0.7700	84.0104	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(81)
Northeast	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(75)

Solar gains	200.4180	310.5132	480.9626	686.5536	804.4138	901.8777	848.5533	739.4812	580.9975	385.5546	243.5487	165.8678	(83)
Total gains	820.6548	926.0868	1072.6400	1240.9845	1320.4684	1383.6202	1310.2562	1209.9830	1072.9380	914.9670	814.6817	768.7984	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8170	36.1334	36.0299	36.2348	36.2348	36.3342	36.4314	36.5265	36.6193	36.3342	36.5265	36.3342	
alpha	3.3878	3.4089	3.4020	3.4157	3.4157	3.4223	3.4288	3.4351	3.4413	3.4223	3.4351	3.4223	
util living area													
	0.9769	0.9651	0.9309	0.8487	0.7129	0.5155	0.3861	0.4144	0.6695	0.8834	0.9593	0.9804	(86)
MIT	19.3792	19.5691	19.9562	20.4264	20.7682	20.9438	20.9842	20.9806	20.8626	20.4412	19.8669	19.3678	(87)
Th 2	19.7703	19.7797	19.7766	19.7826	19.7826	19.7855	19.7884	19.7911	19.7938	19.7855	19.7911	19.7855	(88)
util rest of house													
	0.9711	0.9565	0.9137	0.8118	0.6454	0.4184	0.2708	0.2922	0.5746	0.8448	0.9474	0.9754	(89)
MIT 2	17.6750	17.9531	18.5002	19.1450	19.5708	19.7513	19.7831	19.7845	19.6930	19.1863	18.3927	17.6687	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.0205	18.2808	18.7954	19.4048	19.8135	19.9930	20.0266	20.0270	19.9301	19.4407	18.6916	18.0132	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8705	18.1308	18.6454	19.2548	19.6635	19.8430	19.8766	19.8770	19.7801	19.2907	18.5416	17.8632	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9581	0.9404	0.8930	0.7928	0.6381	0.4233	0.2795	0.3012	0.5734	0.8250	0.9301	0.9637	(94)
Useful gains	786.2366	870.8636	957.9062	983.8496	842.5499	585.6747	366.1934	364.4066	615.2563	754.8463	757.7054	740.8587	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1756.4818	1722.3387	1567.7064	1305.7703	958.9063	606.4651	369.6705	368.7563	672.8785	1053.3595	1413.0996	1717.1512	(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													
	721.8624	572.1912	453.6914	231.7829	86.5691	0.0000	0.0000	0.0000	0.0000	222.0938	471.8838	726.3617	(98)

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

Space heating			3486.4364 (98)
Space heating per m2		(98) / (4) =	35.8097 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3852.4159	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	721.8624	572.1912	453.6914	231.7829	86.5691	0.0000	0.0000	0.0000	0.0000	222.0938	471.8838	726.3617	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	797.6381	632.2555	501.3164	256.1137	95.6565	0.0000	0.0000	0.0000	0.0000	245.4075	521.4186	802.6096	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8571	89.8037	89.6459	89.2666	88.5200	87.3000	87.3000	87.3000	87.3000	89.2055	89.6787	89.8753	(217)
Fuel for water heating, kWh/month													
	194.8296	170.9390	177.7469	157.0894	153.0993	135.5997	127.2799	143.7432	144.7757	163.1588	175.2612	189.1269	(219)
Water heating fuel used												1932.6495	(219)
Annual totals kWh/year													
Space heating fuel - main system												3852.4159	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												4928.6749	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3852.4159	10.2300	394.1021	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1932.6495	10.2300	197.7100	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			380.3456	(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	3852.4159	0.2160	832.1218	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.6495	0.2160	417.4523	(264)
Space and water heating			1249.5741	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1328.3540	0.5190	-689.4157	(269)
Total kg/year			805.1075	(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	3852.4159	1.2200	4699.9473	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.6495	1.2200	2357.8324	(264)
Space and water heating			7057.7797	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)

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

Energy saving/generation technologies			
PV Unit	-1328.3540	3.0700	-4078.0469 (269)
Primary energy kWh/year			4428.6610 (272)
Primary energy kWh/m2/year			45.4875 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 90

(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	+ 1.1	-£ 85	-192 kg (23.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.97 kg/m²	B 91	A 92
Total Savings	£85	1.97 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
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	£173	£192	-£18
Mains gas	£695	£591	£103
Space heating	£525	£525	£0
Water heating	£198	£113	£85
Lighting	£146	£146	£0
Generated (PV)	-£488	-£488	£0
Total cost of fuels	£380	£295	£85
Total cost of uses	£381	£296	£85
Delivered energy	51 kWh/m²	41 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	45 kWh/m²	34 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.7000	
Infiltration rate			0.4341	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4341	(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	0.5535	0.5426	0.5318	0.4775	0.4666	0.4124	0.4124	0.4015	0.4341	0.4666	0.4884	0.5101	(22b)
Effective ac	0.6532	0.6472	0.6414	0.6140	0.6089	0.5850	0.5850	0.5806	0.5942	0.6089	0.6192	0.6301	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.1319	53.6390	53.1559	50.8866	50.4620	48.4855	48.4855	48.1195	49.2468	50.4620	51.3209	52.2189	(38)
Heat transfer coeff	139.5057	139.0128	138.5296	136.2603	135.8357	133.8592	133.8592	133.4932	134.6205	135.8357	136.6946	137.5926	(39)
Average = Sum(39)m / 12 =												136.2583	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4329	1.4278	1.4229	1.3996	1.3952	1.3749	1.3749	1.3711	1.3827	1.3952	1.4040	1.4132	(40)
HLP (average)												1.3995	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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												1.1684	(H8)
Utilisation factor												0.5751	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-866.7922	(H17)
Solar input	-25.1352	-41.9435	-71.4346	-95.7364	-118.2743	-116.2825	-114.7457	-100.2539	-78.5189	-53.6192	-29.8140	-21.0339	(63)
								Solar input (sum of months) = Sum(63)m =				-866.7922	(63)
Output from w/h													
	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
								Total per year (kWh/year) = Sum(64)m =				854.5783	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	
Northeast	2.6200	11.2829	0.4600	0.0000	0.7700	10.4706	(75)
Southeast	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(77)
South	1.0300	46.7521	0.4600	0.0000	0.7700	17.0564	(78)
Southwest	5.2500	36.7938	0.4600	0.0000	0.7700	68.4200	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(81)
Northeast	3.3300	11.2829	0.4600	0.0000	0.7700	13.3081	(75)

Solar gains	160.3087	290.5628	443.4668	625.4895	769.3059	793.7835	752.8037	641.0368	505.8592	333.5664	195.2132	135.1125	(83)
Total gains	780.5455	906.1364	1035.1442	1179.9204	1285.3606	1275.5260	1214.5066	1111.5386	997.7997	862.9788	766.3462	738.0431	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7682	34.8915	35.0132	35.5963	35.7076	36.2348	36.2348	36.3342	36.0299	35.7076	35.4832	35.2517	
alpha	3.3179	3.3261	3.3342	3.3731	3.3805	3.4157	3.4157	3.4223	3.4020	3.3805	3.3655	3.3501	
util living area													
	0.9822	0.9700	0.9437	0.8803	0.7650	0.6032	0.4630	0.5175	0.7444	0.9169	0.9714	0.9850	(86)
MIT	19.1792	19.4150	19.7954	20.2841	20.6711	20.8970	20.9685	20.9541	20.7808	20.2700	19.6452	19.1462	(87)
Th 2	19.7382	19.7421	19.7459	19.7637	19.7670	19.7826	19.7826	19.7855	19.7766	19.7670	19.7603	19.7532	(88)
util rest of house													
	0.9777	0.9626	0.9295	0.8499	0.7067	0.5106	0.3444	0.3953	0.6611	0.8888	0.9630	0.9813	(89)
MIT 2	17.3658	17.7079	18.2535	18.9431	19.4447	19.7094	19.7692	19.7638	19.5963	18.9444	18.0560	17.3273	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	17.7335	18.0540	18.5661	19.2150	19.6933	19.9502	20.0123	20.0051	19.8365	19.2132	18.3782	17.6961	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5835	17.9040	18.4161	19.0650	19.5433	19.8002	19.8623	19.8551	19.6865	19.0632	18.2282	17.5461	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9663	0.9472	0.9093	0.8288	0.6947	0.5121	0.3525	0.4027	0.6541	0.8678	0.9480	0.9712	(94)
Useful gains	754.2701	858.2840	941.2845	977.9670	892.9432	653.1736	428.1002	447.6614	652.6309	748.8865	726.5051	716.8126	(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	1853.1209	1807.7225	1650.7340	1385.0797	1065.4039	696.0887	436.6924	461.2375	752.0563	1149.6006	1521.1681	1836.3232	(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	817.5450	638.0227	527.8304	293.1212	128.3108	0.0000	0.0000	0.0000	0.0000	298.1313	572.1573	832.9160	(98)
Space heating												4108.0347	(98)
Space heating per m2											(98) / (4) =	42.1943	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4539.2648	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	817.5450	638.0227	527.8304	293.1212	128.3108	0.0000	0.0000	0.0000	0.0000	298.1313	572.1573	832.9160	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	903.3647	704.9975	583.2380	323.8908	141.7798	0.0000	0.0000	0.0000	0.0000	329.4269	632.2181	920.3491	(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	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9888	90.0089	90.0289	90.0649	90.1086	87.3000	87.3000	87.3000	87.3000	89.7249	89.9000	89.9996	(217)
Fuel for water heating, kWh/month	166.6129	123.9499	97.6445	49.3998	19.1427	2.4010	0.0000	28.9048	54.8342	102.4548	141.6662	165.4946	(219)
Water heating fuel used												952.5053	(219)
Annual totals kWh/year													
Space heating fuel - main system												4539.2648	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												4825.0022	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4539.2648	3.4800	157.9664	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.5053	3.4800	33.1472	(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	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			223.1669	(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] =	0.6584	(257)
SAP value	90.8153	
SAP rating (Section 12)	91	(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	4539.2648	0.2160	980.4812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.5053	0.2160	205.7411	(264)
Space and water heating			1186.2223	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			840.1698	(272)
CO2 emissions per m2			8.6300	(273)
EI value			92.0917	
EI rating			92	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7000	
Infiltration rate		0.4341	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4341	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4558	0.4232	0.4341	0.4124	0.4124	0.4015	0.3907	0.3798	0.3690	0.4015	0.3798	0.4015	(22b)
Effective ac	0.6039	0.5896	0.5942	0.5850	0.5850	0.5806	0.5763	0.5721	0.5681	0.5806	0.5721	0.5806	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.0472	48.8613	49.2468	48.4855	48.4855	48.1195	47.7632	47.4167	47.0800	48.1195	47.4167	48.1195	(38)
Heat transfer coeff	135.4209	134.2350	134.6205	133.8592	133.8592	133.4932	133.1369	132.7904	132.4537	133.4932	132.7904	133.4932	(39)
Average = Sum(39)m / 12 =												133.6371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3909	1.3787	1.3827	1.3749	1.3749	1.3711	1.3675	1.3639	1.3605	1.3711	1.3639	1.3711	(40)
HLP (average)												1.3726	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3077	(H8)
Utilisation factor												0.5345	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-901.6911	(H17)
Solar input	-29.4153	-41.8267	-71.8901	-96.9964	-113.9281	-121.6932	-119.1340	-106.6286	-83.4828	-57.7171	-34.7906	-24.1880	(63)
									Solar input (sum of months) = Sum(63)m =			-901.6911	(63)
Output from w/h													
	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
									Total per year (kWh/year) = Sum(64)m =			827.3824	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	
Northeast	2.6200	14.6176	0.4600	0.0000	0.7700	13.5652	(75)
Southeast	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(77)
South	1.0300	56.7559	0.4600	0.0000	0.7700	20.7060	(78)
Southwest	5.2500	45.1778	0.4600	0.0000	0.7700	84.0104	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(81)
Northeast	3.3300	14.6176	0.4600	0.0000	0.7700	17.2413	(75)

Solar gains	200.4180	310.5132	480.9626	686.5536	804.4138	901.8777	848.5533	739.4812	580.9975	385.5546	243.5487	165.8678	(83)
Total gains	820.6548	926.0868	1072.6400	1240.9845	1320.4684	1383.6202	1310.2562	1209.9830	1072.9380	914.9670	814.6817	768.7984	(84)

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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, n1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.8170	36.1334	36.0299	36.2348	36.2348	36.3342	36.4314	36.5265	36.6193	36.3342	36.5265	36.3342	
alpha	3.3878	3.4089	3.4020	3.4157	3.4157	3.4223	3.4288	3.4351	3.4413	3.4223	3.4351	3.4223	
util living area													
	0.9769	0.9651	0.9309	0.8487	0.7129	0.5155	0.3861	0.4144	0.6695	0.8834	0.9593	0.9804	(86)
MIT	19.3792	19.5691	19.9562	20.4264	20.7682	20.9438	20.9842	20.9806	20.8626	20.4412	19.8669	19.3678	(87)
Th 2	19.7703	19.7797	19.7766	19.7826	19.7826	19.7855	19.7884	19.7911	19.7938	19.7855	19.7911	19.7855	(88)
util rest of house													
	0.9711	0.9565	0.9137	0.8118	0.6454	0.4184	0.2708	0.2922	0.5746	0.8448	0.9474	0.9754	(89)
MIT 2	17.6750	17.9531	18.5002	19.1450	19.5708	19.7513	19.7831	19.7845	19.6930	19.1863	18.3927	17.6687	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)

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

MIT	18.0205	18.2808	18.7954	19.4048	19.8135	19.9930	20.0266	20.0270	19.9301	19.4407	18.6916	18.0132	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8705	18.1308	18.6454	19.2548	19.6635	19.8430	19.8766	19.8770	19.7801	19.2907	18.5416	17.8632	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9581	0.9404	0.8930	0.7928	0.6381	0.4233	0.2795	0.3012	0.5734	0.8250	0.9301	0.9637	(94)
Useful gains	786.2366	870.8636	957.9062	983.8496	842.5499	585.6747	366.1934	364.4066	615.2563	754.8463	757.7054	740.8587	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1756.4818	1722.3387	1567.7064	1305.7703	958.9063	606.4651	369.6705	368.7563	672.8785	1053.3595	1413.0996	1717.1512	(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	721.8624	572.1912	453.6914	231.7829	86.5691	0.0000	0.0000	0.0000	0.0000	222.0938	471.8838	726.3617	(98)
Space heating												3486.4364	(98)
Space heating per m2											(98) / (4) =	35.8097	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3852.4159	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	721.8624	572.1912	453.6914	231.7829	86.5691	0.0000	0.0000	0.0000	0.0000	222.0938	471.8838	726.3617	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	797.6381	632.2555	501.3164	256.1137	95.6565	0.0000	0.0000	0.0000	0.0000	245.4075	521.4186	802.6096	(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	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9464	89.9615	89.9671	89.9815	89.8425	87.3000	87.3000	87.3000	87.3000	89.5696	89.8220	89.9489	(217)
Fuel for water heating, kWh/month	161.9329	124.1451	97.2052	48.0453	24.0369	0.0000	0.0000	21.6028	49.1482	98.0573	136.2488	162.0814	(219)
Water heating fuel used												922.5039	(219)
Annual totals kWh/year													
Space heating fuel - main system												3852.4159	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												3968.5292	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3852.4159	10.2300	394.1021	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	922.5039	10.2300	94.3721	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			295.3677	(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	3852.4159	0.2160	832.1218	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.5039	0.2160	199.2608	(264)

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

Space and water heating			1031.3827 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1328.3540	0.5190	-689.4157 (269)
Total kg/year			612.8660 (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	3852.4159	1.2200	4699.9473 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	922.5039	1.2200	1125.4547 (264)
Space and water heating			5825.4021 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	396.9635	3.0700	1218.6781 (268)
Energy saving/generation technologies			
PV Unit	-1328.3540	3.0700	-4078.0469 (269)
Primary energy kWh/year			3349.7833 (272)
Primary energy kWh/m2/year			34.4062 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	331.51 (P1)
Transmission heat loss coefficient	85.37 (37)
Summer heat loss coefficient	416.88 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	2.6200	106.0502	0.4600	0.0000	0.9000	115.0305
South East	1.3100	127.3119	0.4600	0.0000	0.9000	69.0463
South	1.0300	118.5567	0.4600	0.0000	0.9000	50.5549
South West	5.2500	127.3119	0.4600	0.0000	0.9000	276.7123
West	1.0300	125.2818	0.4600	0.0000	0.9000	53.4227
North West	6.7100	106.0502	0.4600	0.0000	0.9000	294.6011
North East	3.3300	106.0502	0.4600	0.0000	0.9000	146.2030
total:						1005.5709

	Jun	Jul	Aug	
Solar gains	1086	1006	873	(P4)
Internal gains	479	459	468	
Total summer gains	1565	1464	1341	(P5)
Summer gain/loss ratio	3.75	3.51	3.22	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	19.90	21.56	21.26	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-598	**Issued on Date**	16/07/2024
Assessment Reference	As Built	**Prop Type Ref**	Badlesmere-As-SEMI
Property	27, Goldcrest Road, Botley, Southampton, SO32 2BZ		

SAP Rating	91 B	**DER**	9.47	**TER**	18.80
Environmental	93 A	**% DER<TER**	49.62		
CO_2 Emissions (t/year)	0.45	**DFEE**	46.59	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.74		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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DWELLING AS BUILT

Semi-Detached House, total floor area 80 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.80 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.47 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.92 (measured in this dwelling)
Maximum 10.0 OK

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

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.51 m², No overhang
Windows facing South East: 0.72 m², No overhang
Windows facing South West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4400	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4070	(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	0.5189	0.5087	0.4985	0.4477	0.4375	0.3866	0.3866	0.3764	0.4070	0.4375	0.4578	0.4782	(22b)
Effective ac	0.6346	0.6294	0.6243	0.6002	0.5957	0.5747	0.5747	0.5709	0.5828	0.5957	0.6048	0.6143	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1896	42.8338	42.4851	40.8473	40.5408	39.1143	39.1143	38.8501	39.6638	40.5408	41.1608	41.8089	(38)
Heat transfer coeff	99.0712	98.7155	98.3668	96.7289	96.4225	94.9960	94.9960	94.7318	95.5454	96.4225	97.0424	97.6905	(39)
Average = Sum(39)m / 12 =												96.7274	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2418	1.2373	1.2330	1.2124	1.2086	1.1907	1.1907	1.1874	1.1976	1.2086	1.2164	1.2245	(40)
HLP (average)												1.2124	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	374.3177	372.1854	358.6535	336.8644	314.7557	293.4745	279.6753	285.6863	296.9071	318.9077	344.1597	363.0836	(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	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	479.6579	561.5879	644.2821	735.1563	801.3877	794.4072	755.2121	692.5931	621.1219	535.3775	472.1484	452.0581	(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	33.7403	33.8619	33.9819	34.5573	34.6672	35.1877	35.1877	35.2859	34.9854	34.6672	34.4457	34.2172	
alpha	3.2494	3.2575	3.2655	3.3038	3.3111	3.3458	3.3458	3.3524	3.3324	3.3111	3.2964	3.2811	
util living area													
	0.9872	0.9779	0.9576	0.9075	0.8092	0.6585	0.5165	0.5722	0.7915	0.9375	0.9794	0.9894	(86)
MIT	19.0229	19.2566	19.6420	20.1510	20.5808	20.8561	20.9526	20.9330	20.7161	20.1541	19.5060	18.9922	(87)
Th 2	19.8867	19.8902	19.8937	19.9101	19.9131	19.9274	19.9274	19.9301	19.9219	19.9131	19.9069	19.9005	(88)
util rest of house													
	0.9845	0.9731	0.9481	0.8858	0.7635	0.5775	0.4050	0.4601	0.7251	0.9184	0.9741	0.9871	(89)
MIT 2	17.2581	17.5992	18.1570	18.8877	19.4677	19.8099	19.9021	19.8910	19.6593	18.9082	17.9745	17.2217	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.6227	17.9415	18.4638	19.1486	19.6976	20.0260	20.1191	20.1062	19.8776	19.1655	18.2908	17.5874	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4727	17.7915	18.3138	18.9986	19.5476	19.8760	19.9691	19.9562	19.7276	19.0155	18.1408	17.4374	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9752	0.9599	0.9294	0.8629	0.7455	0.5733	0.4096	0.4631	0.7109	0.8970	0.9613	0.9791	(94)
Useful gains	467.7531	539.0524	598.7725	634.3871	597.4626	455.3949	309.3631	320.7408	441.5813	480.2309	453.8820	442.6060	(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													
	1305.0315	1272.5951	1162.0819	976.8291	756.6861	501.1986	320.0494	336.8884	537.6898	811.4470	1071.4288	1293.1713	(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													
	622.9351	492.9407	419.1022	246.5582	118.4623	0.0000	0.0000	0.0000	0.0000	246.4248	444.6337	632.8206	(98)
Space heating												3223.8775	(98)
Space heating per m2											(98) / (4) =	40.4096	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3562.2956	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	622.9351	492.9407	419.1022	246.5582	118.4623	0.0000	0.0000	0.0000	0.0000	246.4248	444.6337	632.8206	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	688.3261	544.6859	463.0963	272.4400	130.8975	0.0000	0.0000	0.0000	0.0000	272.2926	491.3079	699.2492	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8101	89.7529	89.6324	89.3556	88.8092	87.3000	87.3000	87.3000	87.3000	89.3277	89.6777	89.8342	(217)
Fuel for water heating, kWh/month													
	183.9035	161.3779	167.7807	148.1933	144.1649	128.1956	120.4190	135.8687	136.8056	153.8588	165.4070	178.5362	(219)
Water heating fuel used												1824.5110	(219)
Annual totals kWh/year													
Space heating fuel - main system												3562.2956	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4600.1622	(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	3562.2956	0.2160	769.4559	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.5110	0.2160	394.0944	(264)
Space and water heating			1163.5502	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			755.2818	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.4700	(273)

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

DER		9.4700	ZC1
Total Floor Area	TFA	79.7800	
Assumed number of occupants	N	2.4587	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2651	ZC2
CO2 emissions from cooking, equation (L16)		2.2312	ZC3
Total CO2 emissions		27.9663	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.9663	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	45.1755	48.1283	44.7493	44.3536	41.0963	42.4662	44.3536	44.7493	48.1283	48.4023	50.9589	(61)
Total heat required for water heating calculated for each month													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
								Total per year (kWh/year) = Sum(64)m =				2010.3767	(64)
Heat gains from water heating, kWh/month													
	62.9621	55.2187	57.3586	50.7041	49.0056	42.9938	40.9362	45.8806	46.3951	53.0633	56.8894	61.3774	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	84.6265	82.1707	77.0949	70.4223	65.8678	59.7136	55.0217	61.6675	64.4376	71.3216	79.0130	82.4966	(72)
Total internal gains													
	386.6966	384.2535	370.0993	347.6900	324.9569	303.0532	289.2610	295.8941	307.7425	330.3634	356.2333	375.4664	(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	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	477.5869	547.6749	616.5471	691.3466	744.8356	735.2710	699.5666	646.9839	587.4835	517.1391	466.6654	452.2359	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9980	0.9957	0.9889	0.9637	0.8870	0.7269	0.5592	0.6206	0.8638	0.9786	0.9960	0.9985	(86)
MIT	19.7087	19.8601	20.1164	20.4641	20.7652	20.9407	20.9872	20.9790	20.8516	20.4640	20.0278	19.6869	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9973	0.9943	0.9849	0.9494	0.8433	0.6351	0.4355	0.4946	0.7952	0.9677	0.9943	0.9980	(89)
MIT 2	18.2122	18.4352	18.8096	19.3156	19.7192	19.9241	19.9593	19.9574	19.8374	19.3243	18.6903	18.1882	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5213	18.7295	19.0795	19.5528	19.9353	20.1341	20.1716	20.1684	20.0469	19.5597	18.9666	18.4978	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9918	0.9803	0.9426	0.8424	0.6514	0.4611	0.5206	0.8020	0.9621	0.9920	0.9969	(94)
Useful gains	475.6656	543.1912	604.4008	651.6306	627.4780	478.9734	322.5858	336.8015	471.1769	497.5321	462.9126	450.8347	(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													
	1346.2718	1305.2056	1183.6873	988.2939	761.9733	505.6645	326.3480	343.5284	546.0281	829.0043	1103.9086	1337.5610	(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													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating												3301.1128	(98)
Space heating per m2											(98) / (4) =	41.3777	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3534.3820	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	647.7311	512.0737	430.9891	242.3976	100.0645	0.0000	0.0000	0.0000	0.0000	246.6153	461.5171	659.7244	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	693.5022	548.2588	461.4445	259.5263	107.1355	0.0000	0.0000	0.0000	0.0000	264.0421	494.1297	706.3430	(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													
	202.0037	177.2803	184.4486	163.5966	158.3904	139.5014	133.6530	148.9918	150.6372	171.5305	183.1054	197.2378	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7754	87.5675	87.1161	86.0393	83.9305	80.3000	80.3000	80.3000	80.3000	85.9645	87.2817	87.8566	(217)
Fuel for water heating, kWh/month													
	230.1369	202.4498	211.7275	190.1418	188.7161	173.7253	166.4421	185.5439	187.5930	199.5363	209.7868	224.4996	(219)
Water heating fuel used												2370.2991	(219)
Annual totals kWh/year													
Space heating fuel - main system												3534.3820	(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)												356.9126	(232)
Total delivered energy for all uses												6336.5938	(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	3534.3820	0.2160	763.4265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2370.2991	0.2160	511.9846	(264)
Space and water heating			1275.4111	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Total CO2, kg/m2/year			1499.5738	(272)
Emissions per m2 for space and water heating			15.9866	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3219	(272b)
Emissions per m2 for pumps and fans			0.4879	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9866 * 1.00) + 2.3219 + 0.4879, rounded to 2 d.p.			18.8000	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1455	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.3915	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3621	(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	0.4617	0.4526	0.4436	0.3983	0.3893	0.3440	0.3440	0.3349	0.3621	0.3893	0.4074	0.4255	(22b)
Effective ac	0.6066	0.6024	0.5984	0.5793	0.5758	0.5592	0.5592	0.5561	0.5656	0.5758	0.5830	0.5905	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	41.2814	40.9998	40.7237	39.4270	39.1844	38.0550	38.0550	37.8458	38.4900	39.1844	39.6752	40.1883	(38)
Heat transfer coeff	97.1631	96.8814	96.6053	95.3086	95.0660	93.9366	93.9366	93.7275	94.3716	95.0660	95.5568	96.0699	(39)
Average = Sum(39)m / 12 =												95.3075	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2179	1.2144	1.2109	1.1946	1.1916	1.1774	1.1774	1.1748	1.1829	1.1916	1.1978	1.2042	(40)
HLP (average)												1.1946	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	447.5515	530.2595	614.5686	707.6361	775.2921	770.3155	732.8207	668.0200	595.7713	507.7574	441.9653	420.7243	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.4029	34.5029	34.6015	35.0723	35.1618	35.5846	35.5846	35.6640	35.4205	35.1618	34.9812	34.7944	
alpha	3.2935	3.3002	3.3068	3.3382	3.3441	3.3723	3.3723	3.3776	3.3614	3.3441	3.3321	3.3196	
util living area													
	0.9895	0.9811	0.9621	0.9140	0.8175	0.6682	0.5252	0.5843	0.8037	0.9445	0.9828	0.9915	(86)
MIT	19.0126	19.2471	19.6338	20.1416	20.5755	20.8528	20.9516	20.9304	20.7070	20.1365	19.4862	18.9766	(87)
Th 2	19.9057	19.9085	19.9113	19.9243	19.9267	19.9381	19.9381	19.9402	19.9337	19.9267	19.9218	19.9167	(88)
util rest of house													
	0.9873	0.9769	0.9535	0.8936	0.7731	0.5879	0.4136	0.4720	0.7394	0.9273	0.9784	0.9896	(89)
MIT 2	18.0957	18.3303	18.7137	19.2152	19.6169	19.8554	19.9202	19.9121	19.7466	19.2214	18.5792	18.0678	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2851	18.5197	18.9038	19.4066	19.8149	20.0614	20.1333	20.1225	19.9450	19.4104	18.7665	18.2556	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2851	18.5197	18.9038	19.4066	19.8149	20.0614	20.1333	20.1225	19.9450	19.4104	18.7665	18.2556	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9699	0.9433	0.8817	0.7679	0.5980	0.4352	0.4927	0.7402	0.9167	0.9718	0.9856	(94)
Useful gains	439.7444	514.2867	579.6950	623.9381	595.3378	460.6615	318.9339	329.1667	440.9805	465.4496	429.5148	414.6499	(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													
	1358.8355	1319.4916	1198.2699	1001.3655	771.4508	513.0261	331.9015	348.8965	551.6049	837.5732	1114.8179	1350.3164	(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													
	683.8037	541.0977	460.2197	271.7478	131.0281	0.0000	0.0000	0.0000	0.0000	276.8600	493.4182	696.1359	(98)
Space heating												3554.3111	(98)
Space heating per m2											(98) / (4) =	44.5514	(99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calculated for June, July and August. See Table 10b												
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												

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	0.0000	0.0000	0.0000	0.0000	0.0000	883.0041	695.1309	712.3287	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8141	0.8734	0.8427	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	718.8161	607.1338	600.3148	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	992.3023	946.6035	872.4862	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	196.9101	252.5655	202.4955	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												651.9710	(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	49.2275	63.1414	50.6239	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												162.9928	(107)
Space cooling per m2												2.0430	(108)
Energy for space heating												44.5514	(99)
Energy for space cooling												2.0430	(108)
Total												46.5944	(109)
Dwelling Fabric Energy Efficiency (DFEE)												46.6	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900 (1b)	x	2.5400 (2b)	=	101.3206	(1b) - (3b)
First floor	39.8900 (1c)	x	2.6300 (2c)	=	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1455	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3955	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298	(22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			13.2900	1.3258	17.6193			(27)
GF B&B J150 P/A=0.40			39.8900	0.1300	5.1857			(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.1800	13.8456			(29a)
Plane Ceiling	39.8900		39.8900	0.1300	5.1857			(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9663			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.2689	(36)
Total fabric heat loss (33) + (36) =	53.2352	(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	41.4304	41.1430	40.8612	39.5379	39.2903	38.1377	38.1377	37.9242	38.5817	39.2903	39.7912	40.3148	(38)
Heat transfer coeff	94.6656	94.3782	94.0965	92.7731	92.5255	91.3729	91.3729	91.1595	91.8169	92.5255	93.0264	93.5500	(39)
Average = Sum(39)m / 12 =												92.7719	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1866	1.1830	1.1794	1.1629	1.1598	1.1453	1.1453	1.1426	1.1509	1.1598	1.1660	1.1726	(40)
HLP (average)												1.1628	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)
Energy content (annual)										Total = Sum(45)m =		1456.8563	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	32.0970	28.0723	28.9681	25.2551	24.2328	20.9111	19.3772	22.2356	22.5012	26.2230	28.6244	31.0843	(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	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	122.9337	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2099	17.9502	14.5981	11.0517	8.2613	6.9745	7.5362	9.7959	13.1480	16.6944	19.4848	20.7716	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	218.9801	221.2525	215.5263	203.3359	187.9477	173.4850	163.8230	161.5507	167.2769	179.4673	194.8554	209.3181	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	35.2934	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	43.1412	41.7742	38.9356	35.0765	32.5710	29.0432	26.0446	29.8866	31.2516	35.2459	39.7561	41.7799	(72)
Total internal gains													
	342.2113	340.8570	328.9400	309.3442	288.6601	269.3828	257.2839	261.1132	271.5566	291.2876	313.9765	331.7497	(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	
Northeast	7.5100	11.2829	0.6300	0.7000	0.7700	25.8961	(75)
Southeast	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(77)
Southwest	5.0600	36.7938	0.6300	0.7000	0.7700	56.8980	(79)

Solar gains	90.8903	163.4214	246.4478	343.6566	419.8788	432.2178	410.3056	351.0898	279.7410	186.7758	110.4321	76.7695	(83)
Total gains	433.1016	504.2784	575.3879	653.0008	708.5389	701.6006	667.5895	612.2030	551.2975	478.0634	424.4085	408.5193	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.5247	58.7029	58.8787	59.7186	59.8784	60.6337	60.6337	60.7757	60.3405	59.8784	59.5560	59.2226	
alpha	4.9016	4.9135	4.9252	4.9812	4.9919	5.0422	5.0422	5.0517	5.0227	4.9919	4.9704	4.9482	
util living area													
	0.9987	0.9970	0.9917	0.9707	0.9027	0.7505	0.5827	0.6495	0.8862	0.9844	0.9974	0.9991	(86)
MIT	19.6571	19.8103	20.0706	20.4261	20.7404	20.9314	20.9847	20.9744	20.8293	20.4223	19.9791	19.6360	(87)
Th 2	19.9307	19.9336	19.9365	19.9498	19.9523	19.9640	19.9640	19.9662	19.9595	19.9523	19.9473	19.9420	(88)
util rest of house													
	0.9983	0.9960	0.9886	0.9588	0.8626	0.6596	0.4554	0.5206	0.8236	0.9762	0.9962	0.9987	(89)
MIT 2	18.7060	18.8611	19.1221	19.4812	19.7733	19.9318	19.9601	19.9587	19.8607	19.4839	19.0407	18.6938	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9025	19.0572	19.3180	19.6764	19.9731	20.1383	20.1717	20.1685	20.0608	19.6777	19.2346	18.8884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9862	0.9549	0.8636	0.6763	0.4820	0.5474	0.8309	0.9732	0.9952	0.9983	(94)
Useful gains	432.0941	501.6546	567.4314	623.5564	611.8767	474.5116	321.7777	335.1368	458.0803	465.2667	422.3545	407.8088	(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													
	1382.3519	1336.1274	1206.1322	999.7594	765.4717	506.0479	326.3571	343.5322	547.3010	839.9201	1128.8358	1374.1031	(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													
	706.9918	560.7658	475.1934	270.8661	114.2746	0.0000	0.0000	0.0000	0.0000	278.7422	508.6665	718.9230	(98)
Space heating												3634.4234	(98)
Space heating per m2											(98) / (4) =	45.5556	(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	858.9053	676.1595	692.8119	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8585	0.9202	0.8915	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	737.3479	622.1787	617.6341	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	911.9861	870.3592	807.2455	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	125.7395	184.6463	141.0709	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												451.4567	(104)

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	31.4349	46.1616	35.2677	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												112.8642 (107)
Space cooling per m2												1.4147 (108)
Energy for space heating												45.5556 (99)
Energy for space cooling												1.4147 (108)
Total												46.9703 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4400	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4070	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4273	0.3968	0.4070	0.3866	0.3866	0.3764	0.3663	0.3561	0.3459	0.3764	0.3561	0.3764	(22b)
Effective ac	0.5913	0.5787	0.5828	0.5747	0.5747	0.5709	0.5671	0.5634	0.5598	0.5709	0.5634	0.5709	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	40.2414	39.3855	39.6638	39.1143	39.1143	38.8501	38.5930	38.3429	38.0999	38.8501	38.3429	38.8501	(38)
Heat transfer coeff	96.1231	95.2672	95.5454	94.9960	94.9960	94.7318	94.4747	94.2246	93.9815	94.7318	94.2246	94.7318	(39)
Average = Sum(39)m / 12 =												94.8357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2049	1.1941	1.1976	1.1907	1.1907	1.1874	1.1842	1.1811	1.1780	1.1874	1.1811	1.1874	(40)
HLP (average)												1.1887	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m

	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076 (61)

Total heat required for water heating calculated for each month

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (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

	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865 (64)

Total per year (kWh/year) = Sum(64)m = 1622.0849 (64)
RHI water heating demand 1622 (64)
Heat gains from water heating, kWh/month

	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646 (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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107 (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)

	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469 (71)

Water heating gains (Table 5)

	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137 (72)

Total internal gains

	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420 (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	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723 (83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7751	35.0876	34.9854	35.1877	35.1877	35.2859	35.3819	35.4758	35.5676	35.2859	35.4758	35.2859	
alpha	3.3183	3.3392	3.3324	3.3458	3.3458	3.3524	3.3588	3.3651	3.3712	3.3524	3.3651	3.3524	
util living area	0.9615	0.9474	0.9096	0.8271	0.6953	0.5064	0.3784	0.4003	0.6382	0.8494	0.9371	0.9660	(86)
MIT	19.4980	19.6714	20.0243	20.4535	20.7735	20.9425	20.9837	20.9809	20.8743	20.4991	19.9686	19.4889	(87)
Th 2	19.9161	19.9247	19.9219	19.9274	19.9274	19.9301	19.9327	19.9352	19.9376	19.9301	19.9352	19.9301	(88)
util rest of house	0.9538	0.9371	0.8917	0.7930	0.6365	0.4229	0.2792	0.2965	0.5565	0.8109	0.9225	0.9591	(89)
MIT 2	17.9610	18.2139	18.7111	19.3013	19.7072	19.8903	19.9258	19.9270	19.8369	19.3792	18.6502	17.9577	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2785	18.5149	18.9823	19.5393	19.9274	20.1076	20.1444	20.1447	20.0512	19.6105	18.9226	18.2740	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1285	18.3649	18.8323	19.3893	19.7774	19.9576	19.9944	19.9947	19.9012	19.4605	18.7726	18.1240	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8690	0.7732	0.6274	0.4251	0.2851	0.3025	0.5534	0.7906	0.9017	0.9428	(94)
Useful gains	641.7020	689.2688	727.4927	720.1409	608.2001	424.8616	270.4457	269.1978	449.3670	571.9118	604.2432	610.7590	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1271.5649	1244.6604	1130.5258	939.4436	691.3270	441.2258	273.4432	272.7539	488.8169	763.5899	1024.4639	1243.2587	(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	468.6180	373.2232	299.8566	157.8980	61.8464	0.0000	0.0000	0.0000	0.0000	142.6085	302.5589	470.5798	(98)

Space heating 2277.1893 (98)
RHI space heating demand 2277 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4400	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4070	(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	0.5189	0.5087	0.4985	0.4477	0.4375	0.3866	0.3866	0.3764	0.4070	0.4375	0.4578	0.4782	(22b)
Effective ac	0.6346	0.6294	0.6243	0.6002	0.5957	0.5747	0.5747	0.5709	0.5828	0.5957	0.6048	0.6143	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1896	42.8338	42.4851	40.8473	40.5408	39.1143	39.1143	38.8501	39.6638	40.5408	41.1608	41.8089	(38)
Heat transfer coeff	99.0712	98.7155	98.3668	96.7289	96.4225	94.9960	94.9960	94.7318	95.5454	96.4225	97.0424	97.6905	(39)
Average = Sum(39)m / 12 =												96.7274	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2418	1.2373	1.2330	1.2124	1.2086	1.1907	1.1907	1.1874	1.1976	1.2086	1.2164	1.2245	(40)
HLP (average)												1.2124	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
									Total per year (kWh/year) = Sum(64)m =			1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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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	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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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	33.7403	33.8619	33.9819	34.5573	34.6672	35.1877	35.1877	35.2859	34.9854	34.6672	34.4457	34.2172	
alpha	3.2494	3.2575	3.2655	3.3038	3.3111	3.3458	3.3458	3.3524	3.3324	3.3111	3.2964	3.2811	
util living area													
	0.9691	0.9541	0.9244	0.8589	0.7463	0.5881	0.4496	0.4952	0.7092	0.8869	0.9533	0.9732	(86)
MIT	19.2999	19.5179	19.8690	20.3200	20.6803	20.8982	20.9687	20.9566	20.8020	20.3405	19.7531	19.2675	(87)
Th 2	19.8867	19.8902	19.8937	19.9101	19.9131	19.9274	19.9274	19.9301	19.9219	19.9131	19.9069	19.9005	(88)
util rest of house													
	0.9629	0.9450	0.9091	0.8300	0.6949	0.5085	0.3484	0.3920	0.6356	0.8573	0.9425	0.9678	(89)
MIT 2	17.6570	17.9719	18.4740	19.1109	19.5836	19.8472	19.9113	19.9059	19.7478	19.1558	18.3255	17.6191	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	17.9964	18.2913	18.7621	19.3606	19.8101	20.0643	20.1297	20.1230	19.9656	19.4005	18.6204	17.9596	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8464	18.1413	18.6121	19.2106	19.6601	19.9143	19.9797	19.9730	19.8156	19.2505	18.4704	17.8096	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9256	0.8863	0.8080	0.6815	0.5074	0.3535	0.3963	0.6275	0.8348	0.9232	0.9531	(94)
Useful gains	624.3109	684.0276	721.3446	721.8394	645.9958	472.8506	314.1802	328.3042	479.8653	576.2683	589.7651	598.3771	(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													
	1342.0573	1307.1185	1191.4323	997.3368	767.5340	504.8407	321.0621	338.4729	546.0996	834.1012	1103.4114	1329.5318	(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													
	534.0033	418.7171	349.7453	198.3581	90.4244	0.0000	0.0000	0.0000	0.0000	191.8277	369.8253	543.9791	(98)
Space heating												2696.8803	(98)
Space heating per m2											(98) / (4) =	33.8040	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2979.9783	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	534.0033	418.7171	349.7453	198.3581	90.4244	0.0000	0.0000	0.0000	0.0000	191.8277	369.8253	543.9791	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	590.0589	462.6708	386.4589	219.1802	99.9165	0.0000	0.0000	0.0000	0.0000	211.9643	408.6467	601.0819	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7231	89.6554	89.5134	89.1912	88.5967	87.3000	87.3000	87.3000	87.3000	89.1362	89.5602	89.7509	(217)
Fuel for water heating, kWh/month													
	184.0818	161.5533	168.0038	148.4664	144.5106	128.1956	120.4190	135.8687	136.8056	154.1892	165.6240	178.7018	(219)
Water heating fuel used												1826.4198	(219)
Annual totals kWh/year													
Space heating fuel - main system												2979.9783	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												4019.7536	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2979.9783	3.4800	103.7032	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1826.4198	3.4800	63.5594	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			183.5043	(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] =	0.6177	(257)
SAP value		91.3836	
SAP rating (Section 12)		91	(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	2979.9783	0.2160	643.6753	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.4198	0.2160	394.5067	(264)
Space and water heating			1038.1820	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			629.9135	(272)
CO2 emissions per m2			7.9000	(273)
EI value			93.2354	
EI rating			93	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8869 = 3.924, stars = 4
Water heating environmental impact	0.216 / 0.8869 = 0.2435, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4400	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4070	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4273	0.3968	0.4070	0.3866	0.3866	0.3764	0.3663	0.3561	0.3459	0.3764	0.3561	0.3764	(22b)
Effective ac	0.5913	0.5787	0.5828	0.5747	0.5747	0.5709	0.5671	0.5634	0.5598	0.5709	0.5634	0.5709	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(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	40.2414	39.3855	39.6638	39.1143	39.1143	38.8501	38.5930	38.3429	38.0999	38.8501	38.3429	38.8501	(38)
Heat transfer coeff	96.1231	95.2672	95.5454	94.9960	94.9960	94.7318	94.4747	94.2246	93.9815	94.7318	94.2246	94.7318	(39)
Average = Sum(39)m / 12 =												94.8357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2049	1.1941	1.1976	1.1907	1.1907	1.1874	1.1842	1.1811	1.1780	1.1874	1.1811	1.1874	(40)
HLP (average)												1.1887	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
										Total per year (kWh/year) = Sum(64)m =		1622.0849	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(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	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7751	35.0876	34.9854	35.1877	35.1877	35.2859	35.3819	35.4758	35.5676	35.2859	35.4758	35.2859	
alpha	3.3183	3.3392	3.3324	3.3458	3.3458	3.3524	3.3588	3.3651	3.3712	3.3524	3.3651	3.3524	
util living area													
	0.9615	0.9474	0.9096	0.8271	0.6953	0.5064	0.3784	0.4003	0.6382	0.8494	0.9371	0.9660	(86)
MIT	19.4980	19.6714	20.0243	20.4535	20.7735	20.9425	20.9837	20.9809	20.8743	20.4991	19.9686	19.4889	(87)
Th 2	19.9161	19.9247	19.9219	19.9274	19.9274	19.9301	19.9327	19.9352	19.9376	19.9301	19.9352	19.9301	(88)
util rest of house													
	0.9538	0.9371	0.8917	0.7930	0.6365	0.4229	0.2792	0.2965	0.5565	0.8109	0.9225	0.9591	(89)
MIT 2	17.9610	18.2139	18.7111	19.3013	19.7072	19.8903	19.9258	19.9270	19.8369	19.3792	18.6502	17.9577	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2785	18.5149	18.9823	19.5393	19.9274	20.1076	20.1444	20.1447	20.0512	19.6105	18.9226	18.2740	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1285	18.3649	18.8323	19.3893	19.7774	19.9576	19.9944	19.9947	19.9012	19.4605	18.7726	18.1240	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8690	0.7732	0.6274	0.4251	0.2851	0.3025	0.5534	0.7906	0.9017	0.9428	(94)
Useful gains	641.7020	689.2688	727.4927	720.1409	608.2001	424.8616	270.4457	269.1978	449.3670	571.9118	604.2432	610.7590	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1271.5649	1244.6604	1130.5258	939.4436	691.3270	441.2258	273.4432	272.7539	488.8169	763.5899	1024.4639	1243.2587	(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													
	468.6180	373.2232	299.8566	157.8980	61.8464	0.0000	0.0000	0.0000	0.0000	142.6085	302.5589	470.5798	(98)
Space heating												2277.1893	(98)
Space heating per m2											(98) / (4) =	28.5434	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2516.2313	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	468.6180	373.2232	299.8566	157.8980	61.8464	0.0000	0.0000	0.0000	0.0000	142.6085	302.5589	470.5798	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	517.8099	412.4013	331.3333	174.4729	68.3386	0.0000	0.0000	0.0000	0.0000	157.5784	334.3192	519.9777	(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													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6437	89.5820	89.4054	89.0118	88.3172	87.3000	87.3000	87.3000	87.3000	88.9007	89.4217	89.6646	(217)
Fuel for water heating, kWh/month													
	184.2449	161.6857	168.2067	148.7656	144.9680	128.1956	120.4190	135.8687	136.8056	154.5976	165.8806	178.8739	(219)
Water heating fuel used												1828.5119	(219)
Annual totals kWh/year													
Space heating fuel - main system												2516.2313	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												3407.6786	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2516.2313	7.3800	185.6979	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1828.5119	7.3800	134.9442	(247)
Pumps and fans for heating	75.0000	28.6600	21.4950	(249)
Energy for lighting	356.9126	28.6600	102.2912	(250)
Additional standing charges			107.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	28.6600	-392.3488	(252)
Total energy cost			159.0794	(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	2516.2313	0.2160	543.5060	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5119	0.2160	394.9586	(264)
Space and water heating			938.4645	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			452.1280	(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	2516.2313	1.2200	3069.8021	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.5119	1.2200	2230.7845	(264)
Space and water heating			5300.5866	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2423.7986	(272)
Primary energy kWh/m2/year			30.3810	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 58	-185 kg (40.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£58	2.32 kg/m²	A 93	A 95
Total Savings	£58	2.32 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 550 TEST (28 Jun 2024)
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	£124	£138	-£14
Mains gas	£428	£356	£72
Space heating	£314	£314	£0
Water heating	£135	£77	£58
Lighting	£102	£102	£0
Generated (PV)	-£392	-£392	£0
Total cost of fuels	£160	£102	£58
Total cost of uses	£159	£101	£58
Delivered energy	43 kWh/m²	31 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	30 kWh/m²	17 kWh/m²	13 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1940	(8)
Pressure test			Yes	
Measured/design AP50			4.9200	
Infiltration rate			0.4400	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4070	(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	0.5189	0.5087	0.4985	0.4477	0.4375	0.3866	0.3866	0.3764	0.4070	0.4375	0.4578	0.4782	(22b)
Effective ac	0.6346	0.6294	0.6243	0.6002	0.5957	0.5747	0.5747	0.5709	0.5828	0.5957	0.6048	0.6143	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904	(36)
Total fabric heat loss	(33) + (36) =	55.8816	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.1896	42.8338	42.4851	40.8473	40.5408	39.1143	39.1143	38.8501	39.6638	40.5408	41.1608	41.8089	(38)
Heat transfer coeff	99.0712	98.7155	98.3668	96.7289	96.4225	94.9960	94.9960	94.7318	95.5454	96.4225	97.0424	97.6905	(39)
Average = Sum(39)m / 12 =												96.7274	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2418	1.2373	1.2330	1.2124	1.2086	1.1907	1.1907	1.1874	1.1976	1.2086	1.2164	1.2245	(40)
HLP (average)												1.2124	(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	2.4587	(42)
Average daily hot water use (litres/day)	92.5935	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1456.8563 (45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)
Total heat required for water heating calculated for each month													
	165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(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												1.2449	(H8)
Utilisation factor												0.5521	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-843.3953	(H17)
Solar input	-24.4568	-40.8113	-69.5064	-93.1523	-115.0818	-113.1437	-111.6485	-97.5478	-76.3995	-52.1719	-29.0093	-20.4662	(63)
											Solar input (sum of months) = Sum(63)m =	-843.3953	(63)
Output from w/h													
	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
											Total per year (kWh/year) = Sum(64)m =	786.4412	(64)
Heat gains from water heating, kWh/month													
	53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)

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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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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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	
Northeast	3.0000	11.2829	0.4600	0.0000	0.7700	11.9893	(75)
Southeast	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(77)
Southwest	5.0600	36.7938	0.4600	0.0000	0.7700	65.9438	(79)
Northeast	4.5100	11.2829	0.4600	0.0000	0.7700	18.0238	(75)

Solar gains	105.3402	189.4025	285.6286	398.2919	486.6320	500.9327	475.5368	406.9068	324.2148	216.4698	127.9888	88.9745	(83)
Total gains	659.3327	738.9924	813.8381	893.3885	947.8549	931.8209	888.7094	828.3607	764.7381	690.3174	638.8533	627.8165	(84)

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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	33.7403	33.8619	33.9819	34.5573	34.6672	35.1877	35.1877	35.2859	34.9854	34.6672	34.4457	34.2172	
alpha	3.2494	3.2575	3.2655	3.3038	3.3111	3.3458	3.3458	3.3524	3.3324	3.3111	3.2964	3.2811	
util living area													
	0.9691	0.9541	0.9244	0.8589	0.7463	0.5881	0.4496	0.4952	0.7092	0.8869	0.9533	0.9732	(86)
MIT	19.2999	19.5179	19.8690	20.3200	20.6803	20.8982	20.9687	20.9566	20.8020	20.3405	19.7531	19.2675	(87)
Th 2	19.8867	19.8902	19.8937	19.9101	19.9131	19.9274	19.9274	19.9301	19.9219	19.9131	19.9069	19.9005	(88)
util rest of house													
	0.9629	0.9450	0.9091	0.8300	0.6949	0.5085	0.3484	0.3920	0.6356	0.8573	0.9425	0.9678	(89)
MIT 2	17.6570	17.9719	18.4740	19.1109	19.5836	19.8472	19.9113	19.9059	19.7478	19.1558	18.3255	17.6191	(90)
Living area fraction										fLA = Living area / (4) =		0.2066	(91)
MIT	17.9964	18.2913	18.7621	19.3606	19.8101	20.0643	20.1297	20.1230	19.9656	19.4005	18.6204	17.9596	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8464	18.1413	18.6121	19.2106	19.6601	19.9143	19.9797	19.9730	19.8156	19.2505	18.4704	17.8096	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9256	0.8863	0.8080	0.6815	0.5074	0.3535	0.3963	0.6275	0.8348	0.9232	0.9531	(94)
Useful gains	624.3109	684.0276	721.3446	721.8394	645.9958	472.8506	314.1802	328.3042	479.8653	576.2683	589.7651	598.3771	(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	1342.0573	1307.1185	1191.4323	997.3368	767.5340	504.8407	321.0621	338.4729	546.0996	834.1012	1103.4114	1329.5318	(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	534.0033	418.7171	349.7453	198.3581	90.4244	0.0000	0.0000	0.0000	0.0000	191.8277	369.8253	543.9791	(98)
Space heating												2696.8803	(98)
Space heating per m2											(98) / (4) =	33.8040	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2979.9783	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	534.0033	418.7171	349.7453	198.3581	90.4244	0.0000	0.0000	0.0000	0.0000	191.8277	369.8253	543.9791	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	590.0589	462.6708	386.4589	219.1802	99.9165	0.0000	0.0000	0.0000	0.0000	211.9643	408.6467	601.0819	(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	140.7071	104.0299	80.8795	39.2667	12.9499	0.0000	0.0000	21.0655	43.0318	85.2666	119.3239	139.9203	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8134	89.8446	89.8812	89.9551	90.0863	87.3000	87.3000	87.3000	87.3000	89.4906	89.6979	89.8264	(217)
Fuel for water heating, kWh/month	156.6660	115.7887	89.9848	43.6514	14.3749	0.0000	0.0000	24.1300	49.2919	95.2799	133.0286	155.7676	(219)
Water heating fuel used												877.9639	(219)
Annual totals kWh/year													
Space heating fuel - main system												2979.9783	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												3121.2977	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2979.9783	3.4800	103.7032	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	877.9639	3.4800	30.5531	(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	356.9126	13.1900	47.0768	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			157.0930	(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] =	0.5288	(257)
SAP value	92.6238	
SAP rating (Section 12)	93	(258)
SAP band	A	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2979.9783	0.2160	643.6753	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	877.9639	0.2160	189.6402	(264)
Space and water heating			833.3155	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			450.9970	(272)
CO2 emissions per m2			5.6500	(273)
EI value			95.1568	
EI rating			95	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8900	(1b)	x 2.5400	(2b) =	101.3206	(1b) - (3b)
First floor	39.8900	(1c)	x 2.6300	(2c) =	104.9107	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		206.2313	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1940	(8)
Pressure test		Yes	
Measured/design AP50		4.9200	
Infiltration rate		0.4400	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4070	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4273	0.3968	0.4070	0.3866	0.3866	0.3764	0.3663	0.3561	0.3459	0.3764	0.3561	0.3764	(22b)
Effective ac	0.5913	0.5787	0.5828	0.5747	0.5747	0.5709	0.5671	0.5634	0.5598	0.5709	0.5634	0.5709	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			8.7800	1.2357	10.8498			(27)
French Door (Uw = 1.30)			4.5100	1.2357	5.5732			(27)
GF B&B J150 P/A=0.40			39.8900	0.1200	4.7868	75.0000	2991.7500	(28a)
EW Brick AAC015	92.3400	15.4200	76.9200	0.2500	19.2300	52.3000	4022.9160	(29a)
Plane Ceiling	39.8900		39.8900	0.1600	6.3824	9.0000	359.0100	(30)
Total net area of external elements Aum(A, m2)			172.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.5912			(33)
E-WM-30			45.7500	0.0000	0.0000	45.0000	2058.7500	(32)
GF Timber			76.9600			9.0000	692.6400	(32c)
1F Timber			92.4000			9.0000	831.6000	(32c)
Internal Floor			39.8900			18.0000	718.0200	(32d)
Internal Ceiling			39.8900			9.0000	359.0100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12033.6960 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		150.8360 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.2904 (36)
Total fabric heat loss	(33) + (36) =	55.8816 (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	40.2414	39.3855	39.6638	39.1143	39.1143	38.8501	38.5930	38.3429	38.0999	38.8501	38.3429	38.8501	(38)
Heat transfer coeff	96.1231	95.2672	95.5454	94.9960	94.9960	94.7318	94.4747	94.2246	93.9815	94.7318	94.2246	94.7318	(39)
Average = Sum(39)m / 12 =												94.8357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2049	1.1941	1.1976	1.1907	1.1907	1.1874	1.1842	1.1811	1.1780	1.1874	1.1811	1.1874	(40)
HLP (average)												1.1887	(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	2.4587 (42)
Average daily hot water use (litres/day)	92.5935 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.8528	98.1491	94.4454	90.7416	87.0379	83.3341	83.3341	87.0379	90.7416	94.4454	98.1491	101.8528	(44)
Energy conte	151.0448	132.1048	136.3203	118.8473	114.0368	98.4051	91.1868	104.6382	105.8879	123.4022	134.7031	146.2789	(45)

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

Energy content (annual)											Total = Sum(45)m =	1456.8563	(45)
Distribution loss (46)m = 0.15 x (45)m													
22.6567	19.8157	20.4480	17.8271	17.1055	14.7608	13.6780	15.6957	15.8832	18.5103	20.2055	21.9418	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Combi loss 14.1191	12.7365	14.0656	13.5716	13.9948	13.5096	13.9389	13.9751	13.5434	14.0363	13.6301	14.1076	(61)	
Total heat required for water heating calculated for each month													
165.1639	144.8412	150.3858	132.4190	128.0316	111.9147	105.1258	118.6133	119.4313	137.4384	148.3332	160.3865	(62)	
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3932	(H8)
Utilisation factor												0.5122	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.5935	(H14)
Volume ratio Veff/V												0.8100	(H15)
Solar storage volume factor												0.9579	(H16)
Solar input												-875.5295	(H17)
Solar input -28.5619	-40.6132	-69.8043	-94.1822	-110.6226	-118.1624	-115.6775	-103.5348	-81.0606	-56.0425	-33.7812	-23.4862	(63)	
										Solar input (sum of months) = Sum(63)m =	-875.5295	(63)	
Output from w/h													
136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)	
										Total per year (kWh/year) = Sum(64)m =	763.3548	(64)	
Heat gains from water heating, kWh/month													
53.7522	47.1090	48.8429	42.9096	41.4159	36.0971	33.8044	38.2860	38.5936	44.5403	48.1963	52.1646	(65)	

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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	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	147.5204	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5247	44.8756	36.4953	27.6293	20.6532	17.4363	18.8405	24.4896	32.8699	41.7360	48.7120	51.9289	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	326.8360	330.2276	321.6810	303.4864	280.5189	258.9328	244.5119	241.1204	249.6670	267.8616	290.8290	312.4151	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	52.2107	(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)													
	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	-98.3469	(71)
Water heating gains (Table 5)													
	72.2475	70.1026	65.6490	59.5967	55.6666	50.1349	45.4360	51.4597	53.6022	59.8660	66.9393	70.1137	(72)
Total internal gains													
	553.9924	549.5899	528.2095	495.0966	461.2229	430.8882	413.1726	421.4539	440.5233	473.8477	510.8645	538.8420	(73)

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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	
Northeast	3.0000	14.6176	0.4600	0.0000	0.7700	15.5327	(75)
Southeast	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(77)
Southwest	5.0600	45.1778	0.4600	0.0000	0.7700	80.9700	(79)
Northeast	4.5100	14.6176	0.4600	0.0000	0.7700	23.3508	(75)

Solar gains	131.3750	201.8617	308.9576	436.2719	508.1108	568.4984	535.3416	468.5525	371.4524	249.5220	159.2749	108.9723	(83)
Total gains	685.3675	751.4516	837.1671	931.3685	969.3338	999.3865	948.5142	890.0064	811.9757	723.3697	670.1394	647.8143	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7751	35.0876	34.9854	35.1877	35.1877	35.2859	35.3819	35.4758	35.5676	35.2859	35.4758	35.2859	
alpha	3.3183	3.3392	3.3324	3.3458	3.3458	3.3524	3.3588	3.3651	3.3712	3.3524	3.3651	3.3524	
util living area													
	0.9615	0.9474	0.9096	0.8271	0.6953	0.5064	0.3784	0.4003	0.6382	0.8494	0.9371	0.9660	(86)
MIT	19.4980	19.6714	20.0243	20.4535	20.7735	20.9425	20.9837	20.9809	20.8743	20.4991	19.9686	19.4889	(87)
Th 2	19.9161	19.9247	19.9219	19.9274	19.9274	19.9301	19.9327	19.9352	19.9376	19.9301	19.9352	19.9301	(88)
util rest of house													
	0.9538	0.9371	0.8917	0.7930	0.6365	0.4229	0.2792	0.2965	0.5565	0.8109	0.9225	0.9591	(89)
MIT 2	17.9610	18.2139	18.7111	19.3013	19.7072	19.8903	19.9258	19.9270	19.8369	19.3792	18.6502	17.9577	(90)
Living area fraction									fLA = Living area / (4) =			0.2066	(91)
MIT	18.2785	18.5149	18.9823	19.5393	19.9274	20.1076	20.1444	20.1447	20.0512	19.6105	18.9226	18.2740	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1285	18.3649	18.8323	19.3893	19.7774	19.9576	19.9944	19.9947	19.9012	19.4605	18.7726	18.1240	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9363	0.9172	0.8690	0.7732	0.6274	0.4251	0.2851	0.3025	0.5534	0.7906	0.9017	0.9428	(94)
Useful gains	641.7020	689.2688	727.4927	720.1409	608.2001	424.8616	270.4457	269.1978	449.3670	571.9118	604.2432	610.7590	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1271.5649	1244.6604	1130.5258	939.4436	691.3270	441.2258	273.4432	272.7539	488.8169	763.5899	1024.4639	1243.2587	(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													
	468.6180	373.2232	299.8566	157.8980	61.8464	0.0000	0.0000	0.0000	0.0000	142.6085	302.5589	470.5798	(98)
Space heating												2277.1893	(98)
Space heating per m2											(98) / (4) =	28.5434	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2516.2313	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	468.6180	373.2232	299.8566	157.8980	61.8464	0.0000	0.0000	0.0000	0.0000	142.6085	302.5589	470.5798	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	517.8099	412.4013	331.3333	174.4729	68.3386	0.0000	0.0000	0.0000	0.0000	157.5784	334.3192	519.9777	(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													
	136.6020	104.2280	80.5815	38.2368	17.4090	0.0000	0.0000	15.0785	38.3707	81.3959	114.5520	136.9003	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7574	89.7816	89.8028	89.8579	89.7772	87.3000	87.3000	87.3000	87.3000	89.3104	89.5980	89.7585	(217)
Fuel for water heating, kWh/month													
	152.1902	116.0907	89.7317	42.5525	19.3913	0.0000	0.0000	17.2721	43.9527	91.1382	127.8510	152.5206	(219)
Water heating fuel used												852.6910	(219)
Annual totals kWh/year													
Space heating fuel - main system												2516.2313	(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)												356.9126	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												2481.8578	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2516.2313	7.3800	185.6979	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	852.6910	7.3800	62.9286	(247)
Pumps and fans for heating	75.0000	28.6600	21.4950	(249)
Pump for solar water heating	50.0000	28.6600	14.3300	(249)
Energy for lighting	356.9126	28.6600	102.2912	(250)
Additional standing charges			107.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	28.6600	-392.3488	(252)
Total energy cost			101.3938	(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	2516.2313	0.2160	543.5060	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6910	0.2160	184.1813	(264)
Space and water heating			727.6872	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.9126	0.5190	185.2377	(268)
Energy saving/generation technologies				

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

PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			267.3007	(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	2516.2313	1.2200	3069.8021	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	852.6910	1.2200	1040.2830	(264)
Space and water heating			4110.0852	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.9126	3.0700	1095.7218	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			1386.7972	(272)
Primary energy kWh/m2/year			17.3828	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	150.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	272.23	(P1)
Transmission heat loss coefficient	55.88	(37)
Summer heat loss coefficient	328.11	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.0000	106.0502	0.4600	0.0000	0.9000	131.7144
South East	0.7200	127.3119	0.4600	0.0000	0.9000	37.9491
South West	5.0600	127.3119	0.4600	0.0000	0.9000	266.6980
North East	4.5100	106.0502	0.4600	0.0000	0.9000	198.0106
total:						634.3721

	Jun	Jul	Aug	
Solar gains	685	634	553	(P4)
Internal gains	428	410	418	
Total summer gains	1113	1045	972	(P5)
Summer gain/loss ratio	3.39	3.18	2.96	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 150.8)	0.94	0.94	0.94	
Threshold temperature	19.74	21.43	21.21	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-625.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Dawlish-As-DET
Property	2, Fulmar Drive, Botley, Southampton, SO32 2TP		

SAP Rating	90 B	**DER**	12.24	**TER**	19.35
Environmental	90 B	**% DER<TER**	36.74		
CO_2 Emissions (t/year)	0.82	**DFEE**	55.45	**TFEE**	62.88
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.81		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 97 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) 19.35 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.24 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)62.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.99 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 1.03 m², No overhang
Windows facing North East: 6.71 m², No overhang
Windows facing South East: 5.95 m², No overhang
Windows facing South West: 1.31 m², No overhang
Windows facing West: 1.03 m², No overhang
Windows facing North West: 5.25 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9900	
Infiltration rate		0.4486	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4486	(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	0.5720	0.5607	0.5495	0.4934	0.4822	0.4262	0.4262	0.4149	0.4486	0.4822	0.5047	0.5271	(22b)
Effective ac	0.6636	0.6572	0.6510	0.6217	0.6163	0.5908	0.5908	0.5861	0.6006	0.6163	0.6273	0.6389	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.9941	54.4677	53.9518	51.5283	51.0749	48.9641	48.9641	48.5732	49.7772	51.0749	51.9922	52.9511	(38)
Heat transfer coeff	140.3678	139.8415	139.3255	136.9020	136.4486	134.3378	134.3378	133.9470	135.1509	136.4486	137.3659	138.3248	(39)
Average = Sum(39)m / 12 =												136.8999	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4417	1.4363	1.4310	1.4061	1.4015	1.3798	1.3798	1.3758	1.3882	1.4015	1.4109	1.4208	(40)
HLP (average)												1.4061	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	417.8424	415.6611	400.6028	376.1820	351.1829	327.2146	311.7142	318.0311	330.6319	355.2780	383.6216	405.0753	(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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(75)
Southeast	2.6200	36.7938	0.4600	0.0000	0.7700	34.1448	(77)
Southwest	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	5.2500	11.2829	0.4600	0.0000	0.7700	20.9812	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	153.4568	279.8873	431.4836	615.0031	761.5153	787.7822	746.2971	632.2586	494.3554	322.4772	187.1881	129.1307	(83)
Total gains	571.2992	695.5484	832.0863	991.1851	1112.6982	1114.9968	1058.0113	950.2898	824.9873	677.7552	570.8097	534.2060	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5547	34.6848	34.8132	35.4295	35.5472	36.1057	36.1057	36.2111	35.8885	35.5472	35.3098	35.0650	
alpha	3.3036	3.3123	3.3209	3.3620	3.3698	3.4070	3.4070	3.4141	3.3926	3.3698	3.3540	3.3377	
util living area													
	0.9929	0.9858	0.9684	0.9200	0.8190	0.6643	0.5219	0.5874	0.8172	0.9549	0.9877	0.9943	(86)
MIT	18.9342	19.1775	19.5848	20.1275	20.5804	20.8597	20.9542	20.9317	20.6960	20.0946	19.4250	18.9062	(87)
Th 2	19.7315	19.7356	19.7396	19.7586	19.7622	19.7788	19.7788	19.7819	19.7724	19.7622	19.7550	19.7475	(88)
util rest of house													
	0.9910	0.9820	0.9597	0.8971	0.7667	0.5702	0.3925	0.4560	0.7432	0.9375	0.9838	0.9928	(89)
MIT 2	17.0071	17.3632	17.9542	18.7335	19.3380	19.6754	19.7585	19.7480	19.5080	18.7061	17.7375	16.9758	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.3978	17.7311	18.2848	19.0161	19.5899	19.9155	20.0009	19.9880	19.7489	18.9876	18.0797	17.3672	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2478	17.5811	18.1348	18.8661	19.4399	19.7655	19.8509	19.8380	19.5989	18.8376	17.9297	17.2172	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9849	0.9721	0.9437	0.8758	0.7506	0.5691	0.4006	0.4626	0.7305	0.9189	0.9748	0.9878	(94)
Useful gains	562.6783	676.1631	785.2399	868.0387	835.2228	634.4907	423.8805	439.6469	602.6250	622.8035	556.4293	527.6629	(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													
	1817.4597	1773.3391	1621.0238	1364.3850	1056.0980	693.9209	436.7219	460.5097	743.1754	1124.0095	1487.6274	1800.5975	(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													
	933.5573	737.3023	621.8232	357.3694	164.3312	0.0000	0.0000	0.0000	0.0000	372.8972	670.4626	947.0633	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			4804.8065 (98)
Space heating per m2		(98) / (4) =	49.3509 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)			0.0000 (201)
Fraction of space heat from main system(s)			1.0000 (202)
Efficiency of main space heating system 1 (in %)			90.5000 (206)
Efficiency of secondary/supplementary heating system, %			0.0000 (208)
Space heating requirement			5309.1785 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	933.5573	737.3023	621.8232	357.3694	164.3312	0.0000	0.0000	0.0000	0.0000	372.8972	670.4626	947.0633	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1031.5551	814.6986	687.0975	394.8833	181.5814	0.0000	0.0000	0.0000	0.0000	412.0412	740.8427	1046.4788	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9792	89.9319	89.8284	89.5747	89.0251	87.3000	87.3000	87.3000	87.3000	89.5782	89.8744	89.9980	(217)
Fuel for water heating, kWh/month													
	194.5653	170.6952	177.3859	156.5490	152.2306	135.5997	127.2799	143.7432	144.7757	162.4800	174.8796	188.8689	(219)
Water heating fuel used												1929.0530	(219)
Annual totals kWh/year													
Space heating fuel - main system												5309.1785	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												6521.4635	(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	5309.1785	0.2160	1146.7826	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.0530	0.2160	416.6754	(264)
Space and water heating			1563.4580	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total CO2, kg/year			1191.4554	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.2400	(273)

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

DER		12.2400	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		29.4684	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.4684	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3695	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.6766	47.2549	43.7846	45.2441	47.2549	47.6766	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
								Total per year (kWh/year) = Sum(64)m =				2130.2265	(64)
Heat gains from water heating, kWh/month													
	66.2474	58.3050	61.0313	54.0209	52.2113	45.8062	43.6140	48.8819	49.4300	56.4550	60.0474	64.5591	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.9700	10.6334	0.6300	0.7000	0.7700	3.1522	(74)
Northeast	6.3400	11.2829	0.6300	0.7000	0.7700	21.8617	(75)
Southeast	5.6200	36.7938	0.6300	0.7000	0.7700	63.1951	(77)
Southwest	1.2400	36.7938	0.6300	0.7000	0.7700	13.9434	(79)
West	0.9700	19.6403	0.6300	0.7000	0.7700	5.8223	(80)
Northwest	4.9500	11.2829	0.6300	0.7000	0.7700	17.0687	(81)

Solar gains	125.0433	228.0527	351.5463	501.0281	620.3589	641.7457	607.9554	515.0744	402.7572	262.7476	152.5268	105.2227	(83)
Total gains	555.3358	656.1592	764.5898	889.0833	982.7395	979.4905	930.2100	844.3167	745.2816	630.4856	548.6059	522.7545	(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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9983	0.9961	0.9893	0.9632	0.8855	0.7303	0.5690	0.6387	0.8771	0.9815	0.9966	0.9987	(86)
MIT	19.5016	19.6713	19.9642	20.3631	20.7120	20.9195	20.9800	20.9669	20.7992	20.3452	19.8547	19.4772	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9977	0.9948	0.9852	0.9483	0.8390	0.6316	0.4320	0.4993	0.8080	0.9716	0.9952	0.9983	(89)
MIT 2	17.8332	18.0829	18.5108	19.0899	19.5579	19.7992	19.8454	19.8411	19.6824	19.0749	18.3608	17.8052	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.1715	18.4049	18.8055	19.3480	19.7919	20.0264	20.0754	20.0694	19.9088	19.3325	18.6637	18.1442	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1715	18.4049	18.8055	19.3480	19.7919	20.0264	20.0754	20.0694	19.9088	19.3325	18.6637	18.1442	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9922	0.9801	0.9400	0.8367	0.6480	0.4599	0.5273	0.8124	0.9653	0.9929	0.9973	(94)
Useful gains	553.3396	651.0520	749.3868	835.7637	822.2329	634.7270	427.7679	445.2287	605.4745	608.5905	544.6948	521.3194	(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													
	1792.4230	1740.2344	1581.3726	1325.4947	1024.0957	678.9819	434.8646	458.1619	730.0386	1105.1657	1470.6714	1782.4914	(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													
	921.8781	731.9305	618.9974	352.6063	150.1860	0.0000	0.0000	0.0000	0.0000	369.4520	666.7032	938.3120	(98)
Space heating												4750.0655	(98)
Space heating per m2											(98) / (4) =	48.7887	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5085.7232	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	921.8781	731.9305	618.9974	352.6063	150.1860	0.0000	0.0000	0.0000	0.0000	369.4520	666.7032	938.3120	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	987.0215	783.6516	662.7382	377.5228	160.7987	0.0000	0.0000	0.0000	0.0000	395.5588	713.8150	1004.6167	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3238	88.1460	87.7438	86.7890	84.7593	80.3000	80.3000	80.3000	80.3000	86.7914	87.9191	88.3921	(217)
Fuel for water heating, kWh/month													
	239.8948	211.8914	223.6015	200.8300	199.0951	185.0896	177.3299	197.6813	199.8645	210.1976	219.3263	233.9649	(219)
Water heating fuel used												2498.7668	(219)
Annual totals kWh/year													
Space heating fuel - main system												5085.7232	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												8057.8510	(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	5085.7232	0.2160	1098.5162	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2498.7668	0.2160	539.7336	(264)
Space and water heating			1638.2498	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1883.9242	(272)
Emissions per m2 for space and water heating			16.8267	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.8267 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			19.3500	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			4.9900	
Infiltration rate			0.3690	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3690	(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	0.4704	0.4612	0.4520	0.4058	0.3966	0.3505	0.3505	0.3413	0.3690	0.3966	0.4151	0.4335	(22b)
Effective ac	0.6106	0.6063	0.6021	0.5824	0.5787	0.5614	0.5614	0.5582	0.5681	0.5787	0.5861	0.5940	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6083	50.2523	49.9032	48.2639	47.9571	46.5293	46.5293	46.2649	47.0793	47.9571	48.5776	49.2263	(38)
Heat transfer coeff	135.9821	135.6260	135.2770	133.6376	133.3308	131.9030	131.9030	131.6386	132.4530	133.3308	133.9513	134.6000	(39)
Average = Sum(39)m / 12 =												133.6361	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3967	1.3930	1.3895	1.3726	1.3695	1.3548	1.3548	1.3521	1.3604	1.3695	1.3758	1.3825	(40)
HLP (average)												1.3726	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.1344	382.7796	369.4377	347.3539	323.8733	302.0408	288.3524	292.3441	304.1161	326.3439	351.9604	372.1904	(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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(75)
Southeast	2.6200	36.7938	0.4600	0.0000	0.7700	34.1448	(77)
Southwest	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	5.2500	11.2829	0.4600	0.0000	0.7700	20.9812	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	153.4568	279.8873	431.4836	615.0031	761.5153	787.7822	746.2971	632.2586	494.3554	322.4772	187.1881	129.1307	(83)
Total gains	537.5912	662.6670	800.9212	962.3570	1085.3886	1089.8230	1034.6496	924.6027	798.4715	648.8211	539.1485	501.3211	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6692	35.7628	35.8551	36.2949	36.3784	36.7722	36.7722	36.8461	36.6195	36.3784	36.2099	36.0354	
alpha	3.3779	3.3842	3.3903	3.4197	3.4252	3.4515	3.4515	3.4564	3.4413	3.4252	3.4140	3.4024	
util living area													
	0.9941	0.9876	0.9710	0.9237	0.8225	0.6681	0.5247	0.5932	0.8240	0.9591	0.9896	0.9954	(86)
MIT	18.9610	19.2031	19.6078	20.1404	20.5899	20.8625	20.9556	20.9324	20.6970	20.0971	19.4330	18.9242	(87)
Th 2	19.7659	19.7687	19.7714	19.7844	19.7868	19.7982	19.7982	19.8003	19.7938	19.7868	19.7819	19.7768	(88)
util rest of house													
	0.9926	0.9843	0.9630	0.9018	0.7715	0.5751	0.3966	0.4629	0.7522	0.9432	0.9863	0.9941	(89)
MIT 2	17.9230	18.1654	18.5671	19.0917	19.5022	19.7284	19.7845	19.7770	19.6121	19.0628	18.4053	17.8942	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	18.1334	18.3758	18.7781	19.3044	19.7228	19.9583	20.0220	20.0113	19.8320	19.2725	18.6137	18.1030	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1334	18.3758	18.7781	19.3044	19.7228	19.9583	20.0220	20.0113	19.8320	19.2725	18.6137	18.1030	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9896	0.9792	0.9545	0.8911	0.7683	0.5887	0.4219	0.4877	0.7549	0.9343	0.9818	0.9917	(94)
Useful gains	531.9856	648.8709	764.4597	857.5716	833.9567	641.5697	436.4679	450.9520	602.7893	606.1664	529.3582	497.1551	(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													
	1881.1008	1827.6711	1660.9462	1390.4155	1069.6813	706.7824	451.3657	475.3837	759.2256	1156.3112	1542.2697	1871.3482	(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													
	1003.7417	792.1537	666.9859	383.6476	175.3791	0.0000	0.0000	0.0000	0.0000	409.3077	729.2963	1022.3997	(98)
Space heating												5182.9118	(98)
Space heating per m2											(98) / (4) =	53.2345	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1239.8881	976.0821	1000.4532	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8142	0.8737	0.8359	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1009.5749	852.7849	836.2876	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1377.3531	1310.6366	1183.8184	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	264.8003	340.6416	258.5629	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												864.0049	(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	66.2001	85.1604	64.6407	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												216.0012	(107)
Space cooling per m2												2.2186	(108)
Energy for space heating												53.2345	(99)
Energy for space cooling												2.2186	(108)
Total												55.4531	(109)
Dwelling Fabric Energy Efficiency (DFEE)												55.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.3682	(36)
Total fabric heat loss (33) + (36) =	78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.9700	10.6334	0.6300	0.7000	0.7700	3.1522	(74)
Northeast	6.3400	11.2829	0.6300	0.7000	0.7700	21.8617	(75)
Southeast	5.6200	36.7938	0.6300	0.7000	0.7700	63.1951	(77)
Southwest	1.2400	36.7938	0.6300	0.7000	0.7700	13.9434	(79)
West	0.9700	19.6403	0.6300	0.7000	0.7700	5.8223	(80)
Northwest	4.9500	11.2829	0.6300	0.7000	0.7700	17.0687	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	125.0433	228.0527	351.5463	501.0281	620.3589	641.7457	607.9554	515.0744	402.7572	262.7476	152.5268	105.2227	(83)
Total gains	509.2568	610.9027	721.0411	848.4253	944.2646	943.8138	896.3374	807.4569	706.9248	589.1568	504.5635	477.4944	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9988	0.9971	0.9915	0.9688	0.8975	0.7482	0.5873	0.6612	0.8936	0.9857	0.9976	0.9991	(86)
MIT	19.4588	19.6297	19.9254	20.3307	20.6906	20.9109	20.9773	20.9619	20.7786	20.3094	19.8140	19.4351	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9984	0.9961	0.9882	0.9558	0.8540	0.6503	0.4474	0.5200	0.8298	0.9778	0.9966	0.9988	(89)
MIT 2	18.4208	18.5934	18.8897	19.2971	19.6307	19.8115	19.8469	19.8438	19.7203	19.2837	18.7883	18.4057	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6312	18.8035	19.0997	19.5067	19.8456	20.0344	20.0761	20.0705	19.9348	19.4916	18.9963	18.6144	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6312	18.8035	19.0997	19.5067	19.8456	20.0344	20.0761	20.0705	19.9348	19.4916	18.9963	18.6144	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9948	0.9854	0.9510	0.8542	0.6675	0.4761	0.5488	0.8357	0.9744	0.9955	0.9984	(94)
Useful gains	508.1316	607.7089	710.4861	806.8219	806.6082	629.9844	426.7732	443.1047	590.7782	574.0798	502.2697	476.7100	(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													
	1851.8277	1791.5941	1619.1735	1345.6215	1030.8886	679.9899	434.9460	458.2973	733.3094	1125.3069	1512.9700	1842.5966	(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													
	999.7099	795.5709	676.0634	387.9357	166.8647	0.0000	0.0000	0.0000	0.0000	410.1130	727.7042	1016.2197	(98)
Space heating												5180.1815	(98)
Space heating per m2											(98) / (4) =	53.2065	(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	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8319	0.8975	0.8596	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	978.4305	831.0504	815.7189	0.0000	0.0000	0.0000	0.0000	(102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1206.7294	1149.0123	1046.9457	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	164.3752	236.5637	172.0328	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												572.9716	(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	41.0938	59.1409	43.0082	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												143.2429	(107)
Space cooling per m2												1.4713	(108)
Energy for space heating												53.2065	(99)
Energy for space cooling												1.4713	(108)
Total												54.6777	(109)
Target Fabric Energy Efficiency (TFEE)												62.9	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9900	
Infiltration rate		0.4486	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4486	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4710	0.4374	0.4486	0.4262	0.4262	0.4149	0.4037	0.3925	0.3813	0.4149	0.3925	0.4149	(22b)
Effective ac	0.6109	0.5956	0.6006	0.5908	0.5908	0.5861	0.5815	0.5770	0.5727	0.5861	0.5770	0.5861	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6319	49.3654	49.7772	48.9641	48.9641	48.5732	48.1928	47.8228	47.4631	48.5732	47.8228	48.5732	(38)
Heat transfer coeff	136.0056	134.7392	135.1509	134.3378	134.3378	133.9470	133.5665	133.1965	132.8369	133.9470	133.1965	133.9470	(39)
Average = Sum(39)m / 12 =												134.1007	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3969	1.3839	1.3882	1.3798	1.3798	1.3758	1.3719	1.3681	1.3644	1.3758	1.3681	1.3758	(40)
HLP (average)												1.3774	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
RHI water heating demand												1718	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(75)
Southeast	2.6200	45.1778	0.4600	0.0000	0.7700	41.9252	(77)
Southwest	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	5.2500	14.6176	0.4600	0.0000	0.7700	27.1823	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

Solar gains	192.2083	299.7590	469.0655	676.4167	797.5086	896.2320	842.4136	730.6984	569.0787	373.5935	233.9956	158.8012	(83)
Total gains	812.4451	915.3326	1060.7429	1230.8476	1313.5633	1377.9745	1304.1165	1201.2002	1061.0192	903.0059	805.1286	761.7318	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6630	35.9982	35.8885	36.1057	36.1057	36.2111	36.3142	36.4151	36.5137	36.2111	36.4151	36.2111	
alpha	3.3775	3.3999	3.3926	3.4070	3.4070	3.4141	3.4209	3.4277	3.4342	3.4141	3.4277	3.4141	
util living area													
	0.9776	0.9663	0.9330	0.8519	0.7162	0.5185	0.3889	0.4182	0.6754	0.8872	0.9607	0.9809	(86)
MIT	19.3616	19.5505	19.9384	20.4150	20.7630	20.9422	20.9837	20.9798	20.8578	20.4282	19.8521	19.3533	(87)
Th 2	19.7657	19.7757	19.7724	19.7788	19.7788	19.7819	19.7850	19.7879	19.7907	19.7819	19.7879	19.7819	(88)
util rest of house													
	0.9720	0.9580	0.9163	0.8153	0.6488	0.4209	0.2726	0.2947	0.5804	0.8494	0.9491	0.9761	(89)
MIT 2	17.6468	17.9241	18.4727	19.1276	19.5620	19.7467	19.7795	19.7810	19.6861	19.1673	18.3699	17.6455	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	17.9945	18.2539	18.7699	19.3886	19.8055	19.9891	20.0237	20.0241	19.9237	19.4229	18.6704	17.9918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8445	18.1039	18.6199	19.2386	19.6555	19.8391	19.8737	19.8741	19.7737	19.2729	18.5204	17.8418	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9591	0.9420	0.8956	0.7961	0.6412	0.4257	0.2813	0.3038	0.5789	0.8293	0.9320	0.9645	(94)
Useful gains	779.2078	862.2589	950.0494	979.8380	842.2143	586.6275	366.8753	364.9729	614.2420	748.9010	750.3547	734.6846	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1760.5190	1725.1814	1570.4403	1308.2611	961.2530	608.0015	370.4688	369.4949	673.9700	1054.5533	1414.5994	1720.1168	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	730.0956	579.8839	461.5708	236.4647	88.5648	0.0000	0.0000	0.0000	0.0000	227.4054	478.2562	733.1616 (98)
Space heating												3535.4029 (98)
RHI space heating demand												3535 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.9900	
Infiltration rate			0.4486	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4486	(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	0.5720	0.5607	0.5495	0.4934	0.4822	0.4262	0.4262	0.4149	0.4486	0.4822	0.5047	0.5271	(22b)
Effective ac	0.6636	0.6572	0.6510	0.6217	0.6163	0.5908	0.5908	0.5861	0.6006	0.6163	0.6273	0.6389	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.9941	54.4677	53.9518	51.5283	51.0749	48.9641	48.9641	48.5732	49.7772	51.0749	51.9922	52.9511	(38)
Heat transfer coeff	140.3678	139.8415	139.3255	136.9020	136.4486	134.3378	134.3378	133.9470	135.1509	136.4486	137.3659	138.3248	(39)
Average = Sum(39)m / 12 =												136.8999	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4417	1.4363	1.4310	1.4061	1.4015	1.3798	1.3798	1.3758	1.3882	1.4015	1.4109	1.4208	(40)
HLP (average)												1.4061	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(75)
Southeast	2.6200	36.7938	0.4600	0.0000	0.7700	34.1448	(77)
Southwest	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	5.2500	11.2829	0.4600	0.0000	0.7700	20.9812	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	153.4568	279.8873	431.4836	615.0031	761.5153	787.7822	746.2971	632.2586	494.3554	322.4772	187.1881	129.1307	(83)
Total gains	773.6936	895.4610	1023.1609	1169.4340	1277.5700	1269.5247	1208.0001	1102.7604	986.2959	851.8896	758.3211	732.0614	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5547	34.6848	34.8132	35.4295	35.5472	36.1057	36.1057	36.2111	35.8885	35.5472	35.3098	35.0650	
alpha	3.3036	3.3123	3.3209	3.3620	3.3698	3.4070	3.4070	3.4141	3.3926	3.3698	3.3540	3.3377	
util living area													
	0.9826	0.9710	0.9456	0.8832	0.7685	0.6066	0.4664	0.5221	0.7502	0.9198	0.9723	0.9854	(86)
MIT	19.1586	19.3915	19.7732	20.2693	20.6632	20.8943	20.9674	20.9524	20.7734	20.2546	19.6281	19.1284	(87)
Th 2	19.7315	19.7356	19.7396	19.7586	19.7622	19.7788	19.7788	19.7819	19.7724	19.7622	19.7550	19.7475	(88)
util rest of house													
	0.9783	0.9639	0.9318	0.8533	0.7105	0.5137	0.3468	0.3989	0.6673	0.8924	0.9641	0.9817	(89)
MIT 2	17.3320	17.6702	18.2184	18.9199	19.4317	19.7036	19.7649	19.7594	19.5855	18.9205	18.0282	17.2980	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.7023	18.0192	18.5336	19.1935	19.6814	19.9450	20.0087	20.0013	19.8263	19.1910	18.3526	17.6691	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5523	17.8692	18.3836	19.0435	19.5314	19.7950	19.8587	19.8513	19.6763	19.0410	18.2026	17.5191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9670	0.9487	0.9117	0.8320	0.6981	0.5150	0.3550	0.4064	0.6597	0.8713	0.9493	0.9718	(94)
Useful gains	748.1986	849.4987	932.8299	972.9736	891.8782	653.8148	428.8816	448.1828	650.7063	742.2691	719.8883	711.4178	(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													
	1860.2013	1813.6315	1655.6930	1388.6603	1068.5791	697.8888	437.7714	462.2867	753.6451	1151.7600	1525.1148	1842.3603	(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													
	827.3300	647.8972	537.8102	299.2944	131.4655	0.0000	0.0000	0.0000	0.0000	304.6612	579.7631	841.4212	(98)

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Space heating		4169.6430 (98)
Space heating per m2	(98) / (4) =	42.8271 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4607.3403 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	827.3300	647.8972	537.8102	299.2944	131.4655	0.0000	0.0000	0.0000	0.0000	304.6612	579.7631	841.4212	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	914.1768	715.9085	594.2654	330.7121	145.2658	0.0000	0.0000	0.0000	0.0000	336.6423	640.6222	929.7472	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9243	89.8690	89.7481	89.4539	88.8469	87.3000	87.3000	87.3000	87.3000	89.4401	89.7980	89.9459	(217)
Fuel for water heating, kWh/month													
	194.6840	170.8147	177.5445	156.7605	152.5360	135.5997	127.2799	143.7432	144.7757	162.7308	175.0284	188.9784	(219)
Water heating fuel used												1930.4757	(219)
Annual totals kWh/year													
Space heating fuel - main system												4607.3403	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												5821.0481	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4607.3403	3.4800	160.3354	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1930.4757	3.4800	67.1806	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			252.9743	(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] =	0.7463 (257)
SAP value		89.5885
SAP rating (Section 12)		90 (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	4607.3403	0.2160	995.1855	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1930.4757	0.2160	416.9828	(264)
Space and water heating			1412.1683	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			1040.1657	(272)
CO2 emissions per m2			10.6800	(273)
EI value			90.2092	
EI rating			90	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.9900	
Infiltration rate			0.4486	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4486	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4710	0.4374	0.4486	0.4262	0.4262	0.4149	0.4037	0.3925	0.3813	0.4149	0.3925	0.4149	(22b)
Effective ac	0.6109	0.5956	0.6006	0.5908	0.5908	0.5861	0.5815	0.5770	0.5727	0.5861	0.5770	0.5861	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6319	49.3654	49.7772	48.9641	48.9641	48.5732	48.1928	47.8228	47.4631	48.5732	47.8228	48.5732	(38)
Heat transfer coeff	136.0056	134.7392	135.1509	134.3378	134.3378	133.9470	133.5665	133.1965	132.8369	133.9470	133.1965	133.9470	(39)
Average = Sum(39)m / 12 =												134.1007	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3969	1.3839	1.3882	1.3798	1.3798	1.3758	1.3719	1.3681	1.3644	1.3758	1.3681	1.3758	(40)
HLP (average)												1.3774	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156 (44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477 (45)
Energy content (annual)										Total = Sum(45)m =		1552.1566 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306 (61)
Total heat required for water heating calculated for each month												
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (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												
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783 (64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401 (64)
Heat gains from water heating, kWh/month												
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520 (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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(75)
Southeast	2.6200	45.1778	0.4600	0.0000	0.7700	41.9252	(77)
Southwest	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	5.2500	14.6176	0.4600	0.0000	0.7700	27.1823	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

Solar gains	192.2083	299.7590	469.0655	676.4167	797.5086	896.2320	842.4136	730.6984	569.0787	373.5935	233.9956	158.8012 (83)
Total gains	812.4451	915.3326	1060.7429	1230.8476	1313.5633	1377.9745	1304.1165	1201.2002	1061.0192	903.0059	805.1286	761.7318 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6630	35.9982	35.8885	36.1057	36.1057	36.2111	36.3142	36.4151	36.5137	36.2111	36.4151	36.2111	
alpha	3.3775	3.3999	3.3926	3.4070	3.4070	3.4141	3.4209	3.4277	3.4342	3.4141	3.4277	3.4141	
util living area													
	0.9776	0.9663	0.9330	0.8519	0.7162	0.5185	0.3889	0.4182	0.6754	0.8872	0.9607	0.9809	(86)
MIT	19.3616	19.5505	19.9384	20.4150	20.7630	20.9422	20.9837	20.9798	20.8578	20.4282	19.8521	19.3533	(87)
Th 2	19.7657	19.7757	19.7724	19.7788	19.7788	19.7819	19.7850	19.7879	19.7907	19.7819	19.7879	19.7819	(88)
util rest of house													
	0.9720	0.9580	0.9163	0.8153	0.6488	0.4209	0.2726	0.2947	0.5804	0.8494	0.9491	0.9761	(89)
MIT 2	17.6468	17.9241	18.4727	19.1276	19.5620	19.7467	19.7795	19.7810	19.6861	19.1673	18.3699	17.6455	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.9945	18.2539	18.7699	19.3886	19.8055	19.9891	20.0237	20.0241	19.9237	19.4229	18.6704	17.9918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8445	18.1039	18.6199	19.2386	19.6555	19.8391	19.8737	19.8741	19.7737	19.2729	18.5204	17.8418	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9591	0.9420	0.8956	0.7961	0.6412	0.4257	0.2813	0.3038	0.5789	0.8293	0.9320	0.9645	(94)
Useful gains	779.2078	862.2589	950.0494	979.8380	842.2143	586.6275	366.8753	364.9729	614.2420	748.9010	750.3547	734.6846	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1760.5190	1725.1814	1570.4403	1308.2611	961.2530	608.0015	370.4688	369.4949	673.9700	1054.5533	1414.5994	1720.1168	(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													
	730.0956	579.8839	461.5708	236.4647	88.5648	0.0000	0.0000	0.0000	0.0000	227.4054	478.2562	733.1616	(98)

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

Space heating		3535.4029 (98)
Space heating per m2	(98) / (4) =	36.3127 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3906.5225 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	730.0956	579.8839	461.5708	236.4647	88.5648	0.0000	0.0000	0.0000	0.0000	227.4054	478.2562	733.1616	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	806.7354	640.7557	510.0230	261.2869	97.8617	0.0000	0.0000	0.0000	0.0000	251.2766	528.4599	810.1233	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8629	89.8109	89.6566	89.2817	88.5373	87.3000	87.3000	87.3000	87.3000	89.2237	89.6868	89.8799	(217)
Fuel for water heating, kWh/month													
	194.8170	170.9252	177.7257	157.0628	153.0695	135.5997	127.2799	143.7432	144.7757	163.1256	175.2453	189.1171	(219)
Water heating fuel used												1932.4864	(219)
Annual totals kWh/year													
Space heating fuel - main system												3906.5225	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												4982.6184	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3906.5225	10.2300	399.6373	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1932.4864	10.2300	197.6934	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			385.8640	(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	3906.5225	0.2160	843.8089	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.4864	0.2160	417.4171	(264)
Space and water heating			1261.2259	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1328.3540	0.5190	-689.4157	(269)
Total kg/year			816.7593	(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	3906.5225	1.2200	4765.9575	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.4864	1.2200	2357.6334	(264)
Space and water heating			7123.5909	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)

Energy saving/generation technologies			
PV Unit	-1328.3540	3.0700	-4078.0469 (269)
Primary energy kWh/year			4494.4721 (272)
Primary energy kWh/m2/year			46.1634 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 90
Current environmental impact rating: B 90

(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	+ 1.1	-£ 85	-192 kg (23.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.97 kg/m²	B 91	A 92
Total Savings	£85	1.97 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£173	£192	-£18
Mains gas	£700	£597	£103
Space heating	£530	£530	£0
Water heating	£198	£113	£85
Lighting	£146	£146	£0
Generated (PV)	-£488	-£488	£0
Total cost of fuels	£385	£301	£85
Total cost of uses	£386	£301	£85
Delivered energy	51 kWh/m²	41 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	46 kWh/m²	35 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.9900	
Infiltration rate			0.4486	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4486	(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	0.5720	0.5607	0.5495	0.4934	0.4822	0.4262	0.4262	0.4149	0.4486	0.4822	0.5047	0.5271	(22b)
Effective ac	0.6636	0.6572	0.6510	0.6217	0.6163	0.5908	0.5908	0.5861	0.6006	0.6163	0.6273	0.6389	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.9941	54.4677	53.9518	51.5283	51.0749	48.9641	48.9641	48.5732	49.7772	51.0749	51.9922	52.9511	(38)
Heat transfer coeff	140.3678	139.8415	139.3255	136.9020	136.4486	134.3378	134.3378	133.9470	135.1509	136.4486	137.3659	138.3248	(39)
Average = Sum(39)m / 12 =												136.8999	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4417	1.4363	1.4310	1.4061	1.4015	1.3798	1.3798	1.3758	1.3882	1.4015	1.4109	1.4208	(40)
HLP (average)												1.4061	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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												1.1684	(H8)
Utilisation factor												0.5751	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-866.7922	(H17)
Solar input	-25.1352	-41.9435	-71.4346	-95.7364	-118.2743	-116.2825	-114.7457	-100.2539	-78.5189	-53.6192	-29.8140	-21.0339	(63)
								Solar input (sum of months) = Sum(63)m =				-866.7922	(63)
Output from w/h													
	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
								Total per year (kWh/year) = Sum(64)m =				854.5783	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	6.7100	11.2829	0.4600	0.0000	0.7700	26.8160	(75)
Southeast	2.6200	36.7938	0.4600	0.0000	0.7700	34.1448	(77)
Southwest	1.3100	36.7938	0.4600	0.0000	0.7700	17.0724	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Northwest	5.2500	11.2829	0.4600	0.0000	0.7700	20.9812	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	153.4568	279.8873	431.4836	615.0031	761.5153	787.7822	746.2971	632.2586	494.3554	322.4772	187.1881	129.1307	(83)
Total gains	773.6936	895.4610	1023.1609	1169.4340	1277.5700	1269.5247	1208.0001	1102.7604	986.2959	851.8896	758.3211	732.0614	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.5547	34.6848	34.8132	35.4295	35.5472	36.1057	36.1057	36.2111	35.8885	35.5472	35.3098	35.0650	
alpha	3.3036	3.3123	3.3209	3.3620	3.3698	3.4070	3.4070	3.4141	3.3926	3.3698	3.3540	3.3377	
util living area	0.9826	0.9710	0.9456	0.8832	0.7685	0.6066	0.4664	0.5221	0.7502	0.9198	0.9723	0.9854	(86)
MIT	19.1586	19.3915	19.7732	20.2693	20.6632	20.8943	20.9674	20.9524	20.7734	20.2546	19.6281	19.1284	(87)
Th 2	19.7315	19.7356	19.7396	19.7586	19.7622	19.7788	19.7788	19.7819	19.7724	19.7622	19.7550	19.7475	(88)
util rest of house	0.9783	0.9639	0.9318	0.8533	0.7105	0.5137	0.3468	0.3989	0.6673	0.8924	0.9641	0.9817	(89)
MIT 2	17.3320	17.6702	18.2184	18.9199	19.4317	19.7036	19.7649	19.7594	19.5855	18.9205	18.0282	17.2980	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	17.7023	18.0192	18.5336	19.1935	19.6814	19.9450	20.0087	20.0013	19.8263	19.1910	18.3526	17.6691	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5523	17.8692	18.3836	19.0435	19.5314	19.7950	19.8587	19.8513	19.6763	19.0410	18.2026	17.5191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9670	0.9487	0.9117	0.8320	0.6981	0.5150	0.3550	0.4064	0.6597	0.8713	0.9493	0.9718	(94)
Useful gains	748.1986	849.4987	932.8299	972.9736	891.8782	653.8148	428.8816	448.1828	650.7063	742.2691	719.8883	711.4178	(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	1860.2013	1813.6315	1655.6930	1388.6603	1068.5791	697.8888	437.7714	462.2867	753.6451	1151.7600	1525.1148	1842.3603	(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	827.3300	647.8972	537.8102	299.2944	131.4655	0.0000	0.0000	0.0000	0.0000	304.6612	579.7631	841.4212	(98)
Space heating												4169.6430	(98)
Space heating per m2											(98) / (4) =	42.8271	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4607.3403	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	827.3300	647.8972	537.8102	299.2944	131.4655	0.0000	0.0000	0.0000	0.0000	304.6612	579.7631	841.4212	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	914.1768	715.9085	594.2654	330.7121	145.2658	0.0000	0.0000	0.0000	0.0000	336.6423	640.6222	929.7472	(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	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9939	90.0153	90.0363	90.0727	90.1169	87.3000	87.3000	87.3000	87.3000	89.7375	89.9064	90.0038	(217)
Fuel for water heating, kWh/month	166.6035	123.9411	97.6364	49.3956	19.1410	2.4010	0.0000	28.9048	54.8342	102.4403	141.6561	165.4867	(219)
Water heating fuel used												952.4406	(219)
Annual totals kWh/year													
Space heating fuel - main system												4607.3403	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												4893.0129	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4607.3403	3.4800	160.3354	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.4406	3.4800	33.1449	(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	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			225.5337	(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] =	0.6654	(257)
SAP value	90.7179	
SAP rating (Section 12)	91	(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	4607.3403	0.2160	995.1855	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.4406	0.2160	205.7272	(264)
Space and water heating			1200.9127	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			854.8601	(272)
CO2 emissions per m2			8.7800	(273)
EI value			91.9534	
EI rating			92	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.9900	
Infiltration rate		0.4486	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4486	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4710	0.4374	0.4486	0.4262	0.4262	0.4149	0.4037	0.3925	0.3813	0.4149	0.3925	0.4149	(22b)
Effective ac	0.6109	0.5956	0.6006	0.5908	0.5908	0.5861	0.5815	0.5770	0.5727	0.5861	0.5770	0.5861	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6319	49.3654	49.7772	48.9641	48.9641	48.5732	48.1928	47.8228	47.4631	48.5732	47.8228	48.5732	(38)
Heat transfer coeff	136.0056	134.7392	135.1509	134.3378	134.3378	133.9470	133.5665	133.1965	132.8369	133.9470	133.1965	133.9470	(39)
Average = Sum(39)m / 12 =												134.1007	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3969	1.3839	1.3882	1.3798	1.3798	1.3758	1.3719	1.3681	1.3644	1.3758	1.3681	1.3758	(40)
HLP (average)												1.3774	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3077	(H8)
Utilisation factor												0.5345	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-901.6911	(H17)
Solar input	-29.4153	-41.8267	-71.8901	-96.9964	-113.9281	-121.6932	-119.1340	-106.6286	-83.4828	-57.7171	-34.7906	-24.1880	(63)
									Solar input (sum of months) = Sum(63)m =			-901.6911	(63)
Output from w/h													
	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
									Total per year (kWh/year) = Sum(64)m =			827.3824	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	6.7100	14.6176	0.4600	0.0000	0.7700	34.7415	(75)
Southeast	2.6200	45.1778	0.4600	0.0000	0.7700	41.9252	(77)
Southwest	1.3100	45.1778	0.4600	0.0000	0.7700	20.9626	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Northwest	5.2500	14.6176	0.4600	0.0000	0.7700	27.1823	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

Solar gains	192.2083	299.7590	469.0655	676.4167	797.5086	896.2320	842.4136	730.6984	569.0787	373.5935	233.9956	158.8012	(83)
Total gains	812.4451	915.3326	1060.7429	1230.8476	1313.5633	1377.9745	1304.1165	1201.2002	1061.0192	903.0059	805.1286	761.7318	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6630	35.9982	35.8885	36.1057	36.1057	36.2111	36.3142	36.4151	36.5137	36.2111	36.4151	36.2111	
alpha	3.3775	3.3999	3.3926	3.4070	3.4070	3.4141	3.4209	3.4277	3.4342	3.4141	3.4277	3.4141	
util living area													
	0.9776	0.9663	0.9330	0.8519	0.7162	0.5185	0.3889	0.4182	0.6754	0.8872	0.9607	0.9809	(86)
MIT	19.3616	19.5505	19.9384	20.4150	20.7630	20.9422	20.9837	20.9798	20.8578	20.4282	19.8521	19.3533	(87)
Th 2	19.7657	19.7757	19.7724	19.7788	19.7788	19.7819	19.7850	19.7879	19.7907	19.7819	19.7879	19.7819	(88)
util rest of house													
	0.9720	0.9580	0.9163	0.8153	0.6488	0.4209	0.2726	0.2947	0.5804	0.8494	0.9491	0.9761	(89)
MIT 2	17.6468	17.9241	18.4727	19.1276	19.5620	19.7467	19.7795	19.7810	19.6861	19.1673	18.3699	17.6455	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)

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

MIT	17.9945	18.2539	18.7699	19.3886	19.8055	19.9891	20.0237	20.0241	19.9237	19.4229	18.6704	17.9918	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8445	18.1039	18.6199	19.2386	19.6555	19.8391	19.8737	19.8741	19.7737	19.2729	18.5204	17.8418	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9591	0.9420	0.8956	0.7961	0.6412	0.4257	0.2813	0.3038	0.5789	0.8293	0.9320	0.9645	(94)
Useful gains	779.2078	862.2589	950.0494	979.8380	842.2143	586.6275	366.8753	364.9729	614.2420	748.9010	750.3547	734.6846	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1760.5190	1725.1814	1570.4403	1308.2611	961.2530	608.0015	370.4688	369.4949	673.9700	1054.5533	1414.5994	1720.1168	(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	730.0956	579.8839	461.5708	236.4647	88.5648	0.0000	0.0000	0.0000	0.0000	227.4054	478.2562	733.1616	(98)
Space heating												3535.4029	(98)
Space heating per m2											(98) / (4) =	36.3127	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3906.5225	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	730.0956	579.8839	461.5708	236.4647	88.5648	0.0000	0.0000	0.0000	0.0000	227.4054	478.2562	733.1616	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	806.7354	640.7557	510.0230	261.2869	97.8617	0.0000	0.0000	0.0000	0.0000	251.2766	528.4599	810.1233	(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	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9516	89.9674	89.9747	89.9901	89.8543	87.3000	87.3000	87.3000	87.3000	89.5851	89.8291	89.9531	(217)
Fuel for water heating, kWh/month	161.9236	124.1369	97.1970	48.0407	24.0338	0.0000	0.0000	21.6028	49.1482	98.0403	136.2380	162.0737	(219)
Water heating fuel used												922.4349	(219)
Annual totals kWh/year													
Space heating fuel - main system												3906.5225	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												4022.5670	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3906.5225	10.2300	399.6373	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	922.4349	10.2300	94.3651	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			300.8958	(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	3906.5225	0.2160	843.8089	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.4349	0.2160	199.2459	(264)

Space and water heating			1043.0548 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1328.3540	0.5190	-689.4157 (269)
Total kg/year			624.5381 (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	3906.5225	1.2200	4765.9575 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	922.4349	1.2200	1125.3706 (264)
Space and water heating			5891.3281 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	396.9635	3.0700	1218.6781 (268)
Energy saving/generation technologies			
PV Unit	-1328.3540	3.0700	-4078.0469 (269)
Primary energy kWh/year			3415.7093 (272)
Primary energy kWh/m2/year			35.0833 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	331.51 (P1)
Transmission heat loss coefficient	85.37 (37)
Summer heat loss coefficient	416.88 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.0300	87.1704	0.4600	0.0000	0.9000	37.1712
North East	6.7100	106.0502	0.4600	0.0000	0.9000	294.6011
South East	2.6200	127.3119	0.4600	0.0000	0.9000	138.0926
South West	1.3100	127.3119	0.4600	0.0000	0.9000	69.0463
West	1.0300	125.2818	0.4600	0.0000	0.9000	53.4227
North West	5.2500	106.0502	0.4600	0.0000	0.9000	230.5001
South East	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						998.3488

	Jun	Jul	Aug	
Solar gains	1080	998	863	(P4)
Internal gains	479	459	468	
Total summer gains	1558	1457	1331	(P5)
Summer gain/loss ratio	3.74	3.50	3.19	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	19.88	21.54	21.24	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-626.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Maplethorne-As-DET
Property	4, House Sparrow Way , Botley, Southampton, SO32 2UR		

SAP Rating	90 B	**DER**	11.03	**TER**	18.63
Environmental	91 B	**% DER<TER**	40.81		
CO_2 Emissions (t/year)	0.70	**DFEE**	50.79	**TFEE**	57.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.81		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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 96 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.03 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.65 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 0.72 m², No overhang
Windows facing South East: 7.64 m², No overhang
Windows facing South West: 0.72 m², No overhang
Windows facing North West: 5.06 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.027 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1617	(8)
Pressure test				Yes	
Measured/design AP50				4.6500	
Infiltration rate				0.3942	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3942	(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	0.5026	0.4927	0.4829	0.4336	0.4237	0.3745	0.3745	0.3646	0.3942	0.4237	0.4434	0.4632	(22b)
Effective ac	0.6263	0.6214	0.6166	0.5940	0.5898	0.5701	0.5701	0.5665	0.5777	0.5898	0.5983	0.6073	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (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	51.1336	50.7332	50.3408	48.4974	48.1525	46.5470	46.5470	46.2497	47.1654	48.1525	48.8502	49.5796	(38)
Heat transfer coeff	124.9182	124.5179	124.1254	122.2820	121.9371	120.3316	120.3316	120.0343	120.9501	121.9371	122.6349	123.3643	(39)
Average = Sum(39)m / 12 =												122.2804	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3052	1.3010	1.2969	1.2776	1.2740	1.2573	1.2573	1.2541	1.2637	1.2740	1.2813	1.2889	(40)
HLP (average)												1.2776	(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		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(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													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
									Total per year (kWh/year) = Sum(64)m =			1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(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	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	415.5677	413.2461	398.1013	373.6727	348.7378	324.9097	309.5836	316.0233	328.7210	353.3739	381.6392	402.9634	(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	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	547.6176	645.8487	736.7382	827.4201	888.1523	874.1383	833.3911	773.8226	706.8911	615.9443	541.2018	515.0665	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9103	36.0258	36.1397	36.6845	36.7882	37.2791	37.2791	37.3714	37.0885	36.7882	36.5790	36.3627	
alpha	3.3940	3.4017	3.4093	3.4456	3.4525	3.4853	3.4853	3.4914	3.4726	3.4525	3.4386	3.4242	
util living area													
	0.9921	0.9855	0.9713	0.9356	0.8594	0.7255	0.5805	0.6329	0.8360	0.9557	0.9867	0.9936	(86)
MIT	19.0371	19.2575	19.6179	20.0966	20.5248	20.8251	20.9412	20.9197	20.6870	20.1291	19.5022	19.0067	(87)
Th 2	19.8368	19.8401	19.8433	19.8584	19.8612	19.8745	19.8745	19.8769	19.8694	19.8612	19.8555	19.8495	(88)
util rest of house													
	0.9902	0.9820	0.9639	0.9177	0.8173	0.6405	0.4538	0.5086	0.7714	0.9399	0.9828	0.9920	(89)
MIT 2	17.2306	17.5531	18.0769	18.7693	19.3558	19.7336	19.8447	19.8321	19.5823	18.8281	17.9209	17.1940	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.5054	17.8124	18.3113	18.9712	19.5336	19.8996	20.0115	19.9976	19.7504	19.0260	18.1615	17.4697	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3554	17.6624	18.1613	18.8212	19.3836	19.7496	19.8615	19.8476	19.6004	18.8760	18.0115	17.3197	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9717	0.9483	0.8960	0.7957	0.6298	0.4522	0.5050	0.7523	0.9203	0.9730	0.9864	(94)
Useful gains	538.5847	627.5776	698.6171	741.3328	706.6712	550.5037	376.8806	390.7934	531.7904	566.8508	526.6029	508.0589	(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													
	1630.8636	1589.1428	1447.4638	1213.1827	936.9186	619.6612	392.4590	413.8268	665.2712	1009.1523	1338.1263	1618.5072	(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													
	812.6555	646.1718	557.1420	339.7319	171.3040	0.0000	0.0000	0.0000	0.0000	329.0723	584.2969	826.1735	(98)
Space heating												4266.5480	(98)
Space heating per m2											(98) / (4) =	44.5779	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4714.4176	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	812.6555	646.1718	557.1420	339.7319	171.3040	0.0000	0.0000	0.0000	0.0000	329.0723	584.2969	826.1735	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	897.9619	714.0020	615.6265	375.3943	189.2862	0.0000	0.0000	0.0000	0.0000	363.6158	645.6319	912.8989	(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													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9177	89.8696	89.7704	89.5437	89.0611	87.3000	87.3000	87.3000	87.3000	89.4967	89.8044	89.9393	(217)
Fuel for water heating, kWh/month													
	193.9381	170.1483	176.8132	156.0014	151.5885	135.0886	126.8064	143.1997	144.2255	162.0040	174.3372	188.2563	(219)
Water heating fuel used												1922.4072	(219)
Annual totals kWh/year													
Space heating fuel - main system												4714.4176	(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)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =											-1218.5571	-1218.5571	(233)
Total delivered energy for all uses												5909.3471	(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	4714.4176	0.2160	1018.3142	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1922.4072	0.2160	415.2400	(264)
Space and water heating			1433.5542	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total CO2, kg/year			1055.9932	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.0300	(273)

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

DER		11.0300	ZC1
Total Floor Area	TFA	95.7100	
Assumed number of occupants	N	2.6961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4290	ZC2
CO2 emissions from cooking, equation (L16)		1.9194	ZC3
Total CO2 emissions		28.3784	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.3784	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(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	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(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	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(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		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(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													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.4746	47.0547	43.5991	45.0524	47.0547	47.4746	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(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													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
								Total per year (kWh/year) = Sum(64)m =				2122.4678	(64)
Heat gains from water heating, kWh/month													
	66.0207	58.1067	60.8266	53.7920	51.9901	45.6121	43.4292	48.6747	49.2205	56.2698	59.8452	64.3395	(65)

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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	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	88.7375	86.4684	81.7562	74.7111	69.8792	63.3502	58.3726	65.4230	68.3619	75.6314	83.1184	86.4778	(72)
Total internal gains													
	427.9393	425.6218	410.4854	385.4333	359.8366	335.3489	320.0307	327.1295	340.4926	365.7691	394.0209	415.3390	(73)

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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	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	541.8754	626.3173	702.6702	776.9384	825.2575	809.2377	771.9855	722.1307	666.7876	592.3217	531.6957	512.0645	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9984	0.9966	0.9913	0.9731	0.9168	0.7829	0.6177	0.6741	0.8909	0.9830	0.9968	0.9988	(86)
MIT	19.6238	19.7772	20.0331	20.3797	20.6964	20.9094	20.9780	20.9667	20.8121	20.4040	19.9549	19.6026	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9979	0.9954	0.9880	0.9619	0.8800	0.6925	0.4822	0.5401	0.8287	0.9740	0.9955	0.9984	(89)
MIT 2	18.0649	18.2910	18.6656	19.1735	19.6083	19.8673	19.9228	19.9190	19.7669	19.2156	18.5609	18.0419	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3021	18.5171	18.8736	19.3570	19.7738	20.0259	20.0833	20.0784	19.9259	19.3964	18.7730	18.2793	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9930	0.9836	0.9541	0.8740	0.7015	0.5026	0.5598	0.8286	0.9677	0.9932	0.9974	(94)
Useful gains	540.0564	621.9495	691.1195	741.2844	721.2339	567.6970	387.9973	404.2737	552.5244	573.1913	528.1042	510.7503	(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													
	1646.3431	1596.2378	1446.1712	1205.0655	927.9554	615.8886	395.3902	416.5610	664.4887	1011.0026	1348.8427	1636.0185	(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													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating												4281.1435	(98)
Space heating per m2											(98) / (4) =	44.7304	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4583.6654	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	823.0773	654.7217	561.7584	333.9223	153.8008	0.0000	0.0000	0.0000	0.0000	325.7316	590.9317	837.1996	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	881.2391	700.9868	601.4544	357.5186	164.6689	0.0000	0.0000	0.0000	0.0000	348.7491	632.6892	896.3593	(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													
	211.2025	186.1774	195.5812	173.5598	168.0365	147.9971	141.7925	158.0654	159.8111	181.8763	192.2217	206.1462	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1363	87.9508	87.5560	86.6717	84.8292	80.3000	80.3000	80.3000	80.3000	86.5017	87.6928	88.2079	(217)
Fuel for water heating, kWh/month													
	239.6317	211.6837	223.3784	200.2496	198.0880	184.3053	176.5785	196.8436	199.0176	210.2576	219.1990	233.7049	(219)
Water heating fuel used												2492.9379	(219)
Annual totals kWh/year													
Space heating fuel - main system												4583.6654	(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)												416.0794	(232)
Total delivered energy for all uses												7567.6827	(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	4583.6654	0.2160	990.0717	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2492.9379	0.2160	538.4746	(264)
Space and water heating			1528.5463	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Total CO2, kg/m2/year			1783.4165	(272)
Emissions per m2 for space and water heating			15.9706	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2562	(272b)
Emissions per m2 for pumps and fans			0.4067	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9706 * 1.00) + 2.2562 + 0.4067, rounded to 2 d.p.			18.6300	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =			30.0000 / (5) =	0.1213	(8)
Pressure test				Yes	
Measured/design AP50				4.6500	
Infiltration rate				0.3538	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3538	(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	0.4510	0.4422	0.4334	0.3891	0.3803	0.3361	0.3361	0.3272	0.3538	0.3803	0.3980	0.4157	(22b)
Effective ac	0.6017	0.5978	0.5939	0.5757	0.5723	0.5565	0.5565	0.5535	0.5626	0.5723	0.5792	0.5864	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004	(36)
Total fabric heat loss	(33) + (36) =	73.7846	(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	49.1274	48.8050	48.4889	47.0041	46.7264	45.4332	45.4332	45.1938	45.9313	46.7264	47.2883	47.8758	(38)
Heat transfer coeff	122.9121	122.5896	122.2735	120.7888	120.5110	119.2179	119.2179	118.9784	119.7160	120.5110	121.0730	121.6605	(39)
Average = Sum(39)m / 12 =												120.7875	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2842	1.2808	1.2775	1.2620	1.2591	1.2456	1.2456	1.2431	1.2508	1.2591	1.2650	1.2711	(40)
HLP (average)												1.2620	(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		2.6961	(42)
Average daily hot water use (litres/day)		98.2325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(65)

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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	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(73)

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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	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	514.0202	613.0743	705.6729	798.6823	860.9265	849.0393	810.0964	748.2124	680.4557	587.1005	509.6425	482.2886	(84)

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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	36.4964	36.5925	36.6871	37.1380	37.2236	37.6274	37.6274	37.7031	37.4708	37.2236	37.0508	36.8719	
alpha	3.4331	3.4395	3.4458	3.4759	3.4816	3.5085	3.5085	3.5135	3.4981	3.4816	3.4701	3.4581	
util living area													
	0.9935	0.9876	0.9744	0.9405	0.8665	0.7349	0.5897	0.6449	0.8463	0.9608	0.9889	0.9948	(86)
MIT	19.0285	19.2492	19.6101	20.0869	20.5180	20.8206	20.9395	20.9164	20.6776	20.1135	19.4857	18.9939	(87)
Th 2	19.8532	19.8559	19.8585	19.8707	19.8730	19.8837	19.8837	19.8857	19.8796	19.8730	19.8684	19.8635	(88)
util rest of house													
	0.9919	0.9845	0.9677	0.9237	0.8260	0.6511	0.4630	0.5209	0.7841	0.9465	0.9856	0.9935	(89)
MIT 2	18.0609	18.2821	18.6413	19.1157	19.5208	19.7842	19.8625	19.8534	19.6755	19.1504	18.5279	18.0340	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.2081	18.4292	18.7886	19.2635	19.6725	19.9418	20.0264	20.0151	19.8279	19.2969	18.6736	18.1800	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2081	18.4292	18.7886	19.2635	19.6725	19.9418	20.0264	20.0151	19.8279	19.2969	18.6736	18.1800	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9886	0.9792	0.9594	0.9124	0.8174	0.6560	0.4805	0.5368	0.7807	0.9368	0.9808	0.9908	(94)
Useful gains	508.1845	600.3168	676.9982	728.6834	703.7345	556.9710	389.2786	401.6363	531.2122	550.0004	499.8375	477.8499	(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													
	1709.4723	1658.5448	1502.5750	1251.7902	960.7718	636.8431	408.4850	430.1189	685.7246	1048.0722	1401.2555	1700.8153	(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													
	893.7582	711.1293	614.2291	376.6369	191.2357	0.0000	0.0000	0.0000	0.0000	370.5655	649.0210	909.8862	(98)
Space heating												4716.4619	(98)
Space heating per m2											(98) / (4) =	49.2787	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1120.6480	882.2122	904.2358	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7693	0.8398	0.8077	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	862.1177	740.9185	730.3885	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1095.5554	1047.8872	977.5367	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	168.0752	228.3847	183.8782	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												580.3381	(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	42.0188	57.0962	45.9696	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												145.0845	(107)
Space cooling per m2												1.5159	(108)
Energy for space heating												49.2787	(99)
Energy for space cooling												1.5159	(108)
Total												50.7946	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.8	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1213	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3713	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3713	(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	0.4734	0.4641	0.4548	0.4084	0.3991	0.3527	0.3527	0.3434	0.3713	0.3991	0.4177	0.4362	(22b)
Effective ac	0.6120	0.6077	0.6034	0.5834	0.5796	0.5622	0.5622	0.5590	0.5689	0.5796	0.5872	0.5951	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			14.1400	1.3258	18.7462			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218			(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.1800	23.7330			(29a)
Plane Ceiling	47.8600		47.8600	0.1300	6.2218			(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.0528			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5562	(36)
Total fabric heat loss					(33) + (36) =		67.6090	(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	49.9694	49.6142	49.2661	47.6309	47.3249	45.9007	45.9007	45.6369	46.4493	47.3249	47.9438	48.5909	(38)
Heat transfer coeff	117.5784	117.2233	116.8751	115.2399	114.9339	113.5097	113.5097	113.2459	114.0583	114.9339	115.5529	116.1999	(39)
Average = Sum(39)m / 12 =												115.2384	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2285	1.2248	1.2211	1.2041	1.2009	1.1860	1.1860	1.1832	1.1917	1.2009	1.2073	1.2141	(40)
HLP (average)												1.2040	(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												2.6961	(42)
Average daily hot water use (litres/day)												98.2325	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)
Energy content (annual)										Total = Sum(45)m =		1545.5797	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	34.0518	29.7819	30.7322	26.7931	25.7086	22.1846	20.5573	23.5898	23.8715	27.8200	30.3677	32.9773	(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	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	134.8053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.5601	20.9259	17.0181	12.8838	9.6308	8.1307	8.7855	11.4198	15.3276	19.4619	22.7149	24.2149	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.2000	251.7859	245.2695	231.3968	213.8850	197.4264	186.4310	183.8451	190.3616	204.2343	221.7460	238.2047	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	36.4805	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	45.7685	44.3183	41.3068	37.2126	34.5546	30.8119	27.6308	31.7067	33.1549	37.3924	42.1773	44.3243	(72)
Total internal gains													
	381.9702	380.4717	367.0360	344.9348	321.5120	299.8106	286.2889	290.4132	302.2856	324.5301	350.0798	370.1855	(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	
Northeast	0.7200	11.2829	0.6300	0.7000	0.7700	2.4827	(75)
Southeast	7.6400	36.7938	0.6300	0.7000	0.7700	85.9093	(77)
Southwest	0.7200	36.7938	0.6300	0.7000	0.7700	8.0962	(79)
Northwest	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	113.9361	200.6956	292.1848	391.5051	465.4209	473.8888	451.9548	395.0012	326.2951	226.5525	137.6748	96.7255	(83)
Total gains	495.9064	581.1673	659.2207	736.4400	786.9329	773.6994	738.2437	685.4143	628.5807	551.0827	487.7546	466.9110	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.5285	56.6997	56.8686	57.6756	57.8291	58.5547	58.5547	58.6911	58.2731	57.8291	57.5194	57.1991	
alpha	4.7686	4.7800	4.7912	4.8450	4.8553	4.9036	4.9036	4.9127	4.8849	4.8553	4.8346	4.8133	
util living area													
	0.9989	0.9975	0.9933	0.9781	0.9285	0.8034	0.6408	0.7010	0.9085	0.9873	0.9978	0.9992	(86)
MIT	19.5796	19.7342	19.9927	20.3450	20.6711	20.8978	20.9743	20.9605	20.7897	20.3668	19.9128	19.5591	(87)
Th 2	19.8973	19.9002	19.9031	19.9168	19.9193	19.9312	19.9312	19.9334	19.9266	19.9193	19.9141	19.9087	(88)
util rest of house													
	0.9986	0.9966	0.9908	0.9687	0.8953	0.7154	0.5026	0.5658	0.8523	0.9803	0.9969	0.9989	(89)
MIT 2	18.6022	18.7587	19.0184	19.3763	19.6858	19.8809	19.9243	19.9214	19.8012	19.4032	18.9484	18.5907	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7509	18.9071	19.1666	19.5237	19.8357	20.0356	20.0841	20.0795	19.9516	19.5498	19.0951	18.7380	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9955	0.9884	0.9642	0.8921	0.7252	0.5237	0.5861	0.8540	0.9770	0.9958	0.9985	(94)
Useful gains	494.9166	578.5395	651.5698	710.0836	702.0581	561.1144	386.6507	401.7298	536.7805	538.3953	485.7226	466.2178	(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													
	1699.1117	1641.9584	1480.4082	1224.2713	935.0719	616.9945	395.4748	416.6864	667.4192	1028.6335	1386.0686	1689.3129	(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													
	895.9212	714.6175	616.6558	370.2151	173.3623	0.0000	0.0000	0.0000	0.0000	364.7372	648.2491	909.9828	(98)
Space heating												4693.7409	(98)
Space heating per m2											(98) / (4) =	49.0413	(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	1066.9910	839.9716	860.6691	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8059	0.8823	0.8507	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	859.9201	741.1018	732.1416	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1007.4958	963.9035	904.1363	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	106.2545	165.7645	127.9641	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												399.9830 (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	26.5636	41.4411	31.9910	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												99.9958 (107)
Space cooling per m2												1.0448 (108)
Energy for space heating												49.0413 (99)
Energy for space cooling												1.0448 (108)
Total												50.0861 (109)
Target Fabric Energy Efficiency (TFEE)												57.6 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.6500	
Infiltration rate			0.3942	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3942	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4139	0.3843	0.3942	0.3745	0.3745	0.3646	0.3548	0.3449	0.3350	0.3646	0.3449	0.3646	(22b)
Effective ac	0.5856	0.5739	0.5777	0.5701	0.5701	0.5665	0.5629	0.5595	0.5561	0.5665	0.5595	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	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8155	46.8522	47.1654	46.5470	46.5470	46.2497	45.9603	45.6788	45.4053	46.2497	45.6788	46.2497	(38)
Heat transfer coeff	121.6002	120.6369	120.9501	120.3316	120.3316	120.0343	119.7449	119.4635	119.1899	120.0343	119.4635	120.0343	(39)
Average = Sum(39)m / 12 =												120.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2705	1.2604	1.2637	1.2573	1.2573	1.2541	1.2511	1.2482	1.2453	1.2541	1.2482	1.2541	(40)
HLP (average)												1.2554	(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	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1545.5797	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(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													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
RHI water heating demand												1711	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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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	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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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	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

Solar gains	163.7030	246.0689	363.1435	492.9981	559.5471	619.8165	586.1345	523.2020	429.5280	300.2395	197.2948	136.5399	(83)
Total gains	781.7044	859.0711	951.9295	1044.3213	1072.4307	1098.5155	1045.0739	991.2588	919.3537	827.7524	766.5777	737.5037	(84)

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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	36.8902	37.1848	37.0885	37.2791	37.2791	37.3714	37.4617	37.5500	37.6362	37.3714	37.5500	37.3714	
alpha	3.4593	3.4790	3.4726	3.4853	3.4853	3.4914	3.4974	3.5033	3.5091	3.4914	3.5033	3.4914	
util living area													
	0.9745	0.9640	0.9359	0.8717	0.7583	0.5718	0.4317	0.4517	0.6939	0.8853	0.9564	0.9779	(86)
MIT	19.4658	19.6295	19.9690	20.3907	20.7303	20.9278	20.9796	20.9766	20.8542	20.4598	19.9273	19.4555	(87)
Th 2	19.8640	19.8720	19.8694	19.8745	19.8745	19.8769	19.8793	19.8816	19.8839	19.8769	19.8816	19.8769	(88)
util rest of house													
	0.9686	0.9559	0.9208	0.8407	0.6985	0.4768	0.3145	0.3304	0.6065	0.8499	0.9446	0.9727	(89)
MIT 2	17.8679	18.1078	18.5897	19.1764	19.6139	19.8287	19.8714	19.8725	19.7700	19.2846	18.5457	17.8618	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1109	18.3393	18.7995	19.3611	19.7837	19.9959	20.0400	20.0405	19.9349	19.4634	18.7559	18.1043	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9609	18.1893	18.6495	19.2111	19.6337	19.8459	19.8900	19.8905	19.7849	19.3134	18.6059	17.9543	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8995	0.8185	0.6840	0.4740	0.3156	0.3314	0.5978	0.8275	0.9259	0.9597	(94)
Useful gains	746.0157	806.5964	856.2504	854.8170	733.5476	520.7214	329.8551	328.4612	549.5789	684.9846	709.8058	707.7904	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1588.2139	1554.9197	1409.0098	1168.5528	858.4157	545.6620	334.0908	333.3598	606.0688	949.8777	1278.9617	1554.9591	(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													
	626.5954	502.8732	411.2529	225.8898	92.9018	0.0000	0.0000	0.0000	0.0000	197.0805	409.7923	630.2935	(98)
Space heating												3096.6795	(98)
RHI space heating demand												3097	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3942	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3942	(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	0.5026	0.4927	0.4829	0.4336	0.4237	0.3745	0.3745	0.3646	0.3942	0.4237	0.4434	0.4632	(22b)
Effective ac	0.6263	0.6214	0.6166	0.5940	0.5898	0.5701	0.5701	0.5665	0.5777	0.5898	0.5983	0.6073	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(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	51.1336	50.7332	50.3408	48.4974	48.1525	46.5470	46.5470	46.2497	47.1654	48.1525	48.8502	49.5796	(38)
Heat transfer coeff	124.9182	124.5179	124.1254	122.2820	121.9371	120.3316	120.3316	120.0343	120.9501	121.9371	122.6349	123.3643	(39)
Average = Sum(39)m / 12 =												122.2804	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3052	1.3010	1.2969	1.2776	1.2740	1.2573	1.2573	1.2541	1.2637	1.2740	1.2813	1.2889	(40)
HLP (average)												1.2776	(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	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290	(61)
Total heat required for water heating calculated for each month													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(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													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
										Total per year (kWh/year) = Sum(64)m =		1711.1415	(64)
Heat gains from water heating, kWh/month													
	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320	(65)

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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	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	(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)													
	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	(71)
Water heating gains (Table 5)													
	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022	(72)
Total internal gains													
	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638	(73)

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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	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031	(83)
Total gains	750.0514	845.6048	927.4230	1005.0707	1052.2981	1027.9275	982.7469	925.8560	867.9959	790.0833	728.8456	713.0669	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9103	36.0258	36.1397	36.6845	36.7882	37.2791	37.2791	37.3714	37.0885	36.7882	36.5790	36.3627	
alpha	3.3940	3.4017	3.4093	3.4456	3.4525	3.4853	3.4853	3.4914	3.4726	3.4525	3.4386	3.4242	
util living area													
	0.9799	0.9686	0.9466	0.8969	0.8035	0.6546	0.5081	0.5525	0.7609	0.9162	0.9684	0.9829	(86)
MIT	19.2810	19.4900	19.8248	20.2596	20.6302	20.8749	20.9612	20.9476	20.7763	20.3024	19.7221	19.2482	(87)
Th 2	19.8368	19.8401	19.8433	19.8584	19.8612	19.8745	19.8745	19.8769	19.8694	19.8612	19.8555	19.8495	(88)
util rest of house													
	0.9753	0.9615	0.9339	0.8714	0.7533	0.5677	0.3908	0.4350	0.6854	0.8901	0.9600	0.9789	(89)
MIT 2	17.5833	17.8866	18.3681	18.9878	19.4812	19.7781	19.8558	19.8494	19.6758	19.0615	18.2353	17.5439	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	17.8416	18.1306	18.5897	19.1813	19.6560	19.9450	20.0239	20.0165	19.8432	19.2502	18.4615	17.8032	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6916	17.9806	18.4397	19.0313	19.5060	19.7950	19.8739	19.8665	19.6932	19.1002	18.3115	17.6532	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9452	0.9133	0.8484	0.7350	0.5610	0.3908	0.4338	0.6717	0.8672	0.9436	0.9676	(94)
Useful gains	722.0381	799.2951	847.0480	852.6518	773.4730	576.6315	384.0345	401.6604	583.0382	685.1879	687.7696	689.9748	(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													
	1672.8527	1628.7630	1482.0242	1238.8723	951.8357	625.1213	393.9564	416.0944	676.4953	1036.4952	1374.9206	1659.6411	(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													
	707.4061	557.4025	472.4223	278.0788	132.7018	0.0000	0.0000	0.0000	0.0000	261.3726	494.7487	721.4317	(98)
Space heating												3625.5644	(98)
Space heating per m2											(98) / (4) =	37.8807	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4006.1486	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	707.4061	557.4025	472.4223	278.0788	132.7018	0.0000	0.0000	0.0000	0.0000	261.3726	494.7487	721.4317	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	781.6642	615.9143	522.0136	307.2694	146.6318	0.0000	0.0000	0.0000	0.0000	288.8095	546.6837	797.1621	(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													
	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8487	89.7915	89.6734	89.4042	88.8574	87.3000	87.3000	87.3000	87.3000	89.3317	89.7096	89.8738	(217)
Fuel for water heating, kWh/month													
	194.0871	170.2964	177.0046	156.2447	151.9360	135.0886	126.8064	143.1997	144.2255	162.3032	174.5214	188.3934	(219)
Water heating fuel used												1924.1070	(219)
Annual totals kWh/year													
Space heating fuel - main system												4006.1486	(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)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) =										-1218.5571		-1218.5571	(233)
Total delivered energy for all uses												5202.7779	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4006.1486	3.4800	139.4140	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1924.1070	3.4800	66.9589	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			230.4186	(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] =	0.6878	(257)
SAP value		90.4056	
SAP rating (Section 12)		90	(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	4006.1486	0.2160	865.3281	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1924.1070	0.2160	415.6071	(264)
Space and water heating			1280.9352	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			903.3743	(272)
CO2 emissions per m2			9.4400	(273)
EI value			91.3970	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8881 = 3.919, stars = 4
Water heating environmental impact	0.216 / 0.8881 = 0.2432, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600 (1b)	x	2.5400 (2b)	=	121.5644	(1b) - (3b)
First floor	47.8500 (1c)	x	2.6300 (2c)	=	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3942	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3942	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4139	0.3843	0.3942	0.3745	0.3745	0.3646	0.3548	0.3449	0.3350	0.3646	0.3449	0.3646	(22b)
Effective ac	0.5856	0.5739	0.5777	0.5701	0.5701	0.5665	0.5629	0.5595	0.5561	0.5665	0.5595	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	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8155	46.8522	47.1654	46.5470	46.5470	46.2497	45.9603	45.6788	45.4053	46.2497	45.6788	46.2497	(38)
Heat transfer coeff	121.6002	120.6369	120.9501	120.3316	120.3316	120.0343	119.7449	119.4635	119.1899	120.0343	119.4635	120.0343	(39)
Average = Sum(39)m / 12 =												120.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2705	1.2604	1.2637	1.2573	1.2573	1.2541	1.2511	1.2482	1.2453	1.2541	1.2482	1.2541	(40)
HLP (average)												1.2554	(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	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

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

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)

Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (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

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (64)

Total per year (kWh/year) = Sum(64)m = 1711.1415 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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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	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (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)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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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	
Northeast	0.7200	14.6176	0.4600	0.0000	0.7700	3.7279	(75)
Southeast	4.3100	45.1778	0.4600	0.0000	0.7700	68.9686	(77)
Southwest	0.7200	45.1778	0.4600	0.0000	0.7700	11.5214	(79)
Northwest	5.0600	14.6176	0.4600	0.0000	0.7700	26.1985	(81)
Southeast	3.3300	45.1778	0.4600	0.0000	0.7700	53.2866	(77)

Solar gains	163.7030	246.0689	363.1435	492.9981	559.5471	619.8165	586.1345	523.2020	429.5280	300.2395	197.2948	136.5399	(83)
Total gains	781.7044	859.0711	951.9295	1044.3213	1072.4307	1098.5155	1045.0739	991.2588	919.3537	827.7524	766.5777	737.5037	(84)

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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	36.8902	37.1848	37.0885	37.2791	37.2791	37.3714	37.4617	37.5500	37.6362	37.3714	37.5500	37.3714	
alpha	3.4593	3.4790	3.4726	3.4853	3.4853	3.4914	3.4974	3.5033	3.5091	3.4914	3.5033	3.4914	
util living area	0.9745	0.9640	0.9359	0.8717	0.7583	0.5718	0.4317	0.4517	0.6939	0.8853	0.9564	0.9779	(86)
MIT	19.4658	19.6295	19.9690	20.3907	20.7303	20.9278	20.9796	20.9766	20.8542	20.4598	19.9273	19.4555	(87)
Th 2	19.8640	19.8720	19.8694	19.8745	19.8745	19.8769	19.8793	19.8816	19.8839	19.8769	19.8816	19.8769	(88)
util rest of house	0.9686	0.9559	0.9208	0.8407	0.6985	0.4768	0.3145	0.3304	0.6065	0.8499	0.9446	0.9727	(89)
MIT 2	17.8679	18.1078	18.5897	19.1764	19.6139	19.8287	19.8714	19.8725	19.7700	19.2846	18.5457	17.8618	(90)
Living area fraction										fLA = Living area / (4) =		0.1521	(91)
MIT	18.1109	18.3393	18.7995	19.3611	19.7837	19.9959	20.0400	20.0405	19.9349	19.4634	18.7559	18.1043	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9609	18.1893	18.6495	19.2111	19.6337	19.8459	19.8900	19.8905	19.7849	19.3134	18.6059	17.9543	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8995	0.8185	0.6840	0.4740	0.3156	0.3314	0.5978	0.8275	0.9259	0.9597	(94)
Useful gains	746.0157	806.5964	856.2504	854.8170	733.5476	520.7214	329.8551	328.4612	549.5789	684.9846	709.8058	707.7904	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1588.2139	1554.9197	1409.0098	1168.5528	858.4157	545.6620	334.0908	333.3598	606.0688	949.8777	1278.9617	1554.9591	(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	626.5954	502.8732	411.2529	225.8898	92.9018	0.0000	0.0000	0.0000	0.0000	197.0805	409.7923	630.2935	(98)
Space heating												3096.6795	(98)
Space heating per m2											(98) / (4) =	32.3548	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3421.7453	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	626.5954	502.8732	411.2529	225.8898	92.9018	0.0000	0.0000	0.0000	0.0000	197.0805	409.7923	630.2935	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	692.3707	555.6610	454.4231	249.6020	102.6540	0.0000	0.0000	0.0000	0.0000	217.7685	452.8092	696.4569	(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	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7835	89.7330	89.5855	89.2500	88.5767	87.3000	87.3000	87.3000	87.3000	89.1155	89.5922	89.8030	(217)
Fuel for water heating, kWh/month	194.2280	170.4073	177.1781	156.5147	152.4176	135.0886	126.8064	143.1997	144.2255	162.6970	174.7501	188.5420	(219)
Water heating fuel used												1926.0550	(219)
Annual totals kWh/year													
Space heating fuel - main system												3421.7453	(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)												416.0794	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) =										-1368.9771		-1368.9771	(233)
Total delivered energy for all uses												4469.9026	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3421.7453	10.2300	350.0445	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1926.0550	10.2300	197.0354	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			327.7159	(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	3421.7453	0.2160	739.0970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0550	0.2160	416.0279	(264)
Space and water heating			1155.1249	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			699.4959	(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	3421.7453	1.2200	4174.5293	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1926.0550	1.2200	2349.7871	(264)
Space and water heating			6524.3164	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			3829.1703	(272)

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

Primary energy kWh/m2/year 40.0080 (273)

SAP 2012 EPC IMPROVEMENTS

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

(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	+ 1.1	-£ 85	-192 kg (27.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	2.00 kg/m²	A 92	A 93
Total Savings	£85	2.00 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£180	£199	-£18
Mains gas	£650	£547	£103
Space heating	£481	£481	£0
Water heating	£197	£112	£85
Lighting	£153	£153	£0
Generated (PV)	-£503	-£503	£0
Total cost of fuels	£327	£243	£85
Total cost of uses	£328	£243	£85
Delivered energy	47 kWh/m²	37 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	40 kWh/m²	29 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1617	(8)
Pressure test		Yes	
Measured/design AP50		4.6500	
Infiltration rate		0.3942	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3942	(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	0.5026	0.4927	0.4829	0.4336	0.4237	0.3745	0.3745	0.3646	0.3942	0.4237	0.4434	0.4632	(22b)
Effective ac	0.6263	0.6214	0.6166	0.5940	0.5898	0.5701	0.5701	0.5665	0.5777	0.5898	0.5983	0.6073	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16149.0750 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.7292 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.7004 (36)
Total fabric heat loss	(33) + (36) =	73.7846 (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	51.1336	50.7332	50.3408	48.4974	48.1525	46.5470	46.5470	46.2497	47.1654	48.1525	48.8502	49.5796	(38)
Heat transfer coeff	124.9182	124.5179	124.1254	122.2820	121.9371	120.3316	120.3316	120.0343	120.9501	121.9371	122.6349	123.3643	(39)
Average = Sum(39)m / 12 =												122.2804	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3052	1.3010	1.2969	1.2776	1.2740	1.2573	1.2573	1.2541	1.2637	1.2740	1.2813	1.2889	(40)
HLP (average)												1.2776	(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		2.6961 (42)
Average daily hot water use (litres/day)		98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1545.5797 (45)
Distribution loss (46)m = 0.15 x (45)m

	24.0365	21.0225	21.6933	18.9128	18.1473	15.6597	14.5110	16.6516	16.8505	19.6376	21.4360	23.2781 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1411	12.7616	14.1037	13.6041	14.0247	13.5343	13.9618	14.0026	13.5723	14.0708	13.6558	14.1290 (61)

Total heat required for water heating calculated for each month

	174.3847	152.9117	158.7259	139.6893	135.0064	117.9324	110.7020	125.0133	125.9089	144.9882	156.5624	169.3163 (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 1.1734 (H8)
Utilisation factor 0.5735 (H9)
Collector performance factor 0.8793 (H10)
Dedicated solar storage volume 75.0000 (H11)
Effective solar volume 75.0000 (H13)
Daily hot water demand 98.2325 (H14)
Volume ratio Veff/V 0.7635 (H15)
Solar storage volume factor 0.9460 (H16)
Solar input -865.2421 (H17)

Solar input	-25.0903	-41.8685	-71.3068	-95.5652	-118.0628	-116.0745	-114.5405	-100.0746	-78.3785	-53.5233	-29.7607	-20.9963 (63)

Solar input (sum of months) = Sum(63)m = -865.2421 (63)

Output from w/h

	149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200 (64)

Total per year (kWh/year) = Sum(64)m = 849.7380 (64)

Heat gains from water heating, kWh/month

	56.8163	49.7903	51.6128	45.3244	43.7326	38.0959	35.6566	40.4117	40.7450	47.0477	50.9304	55.1320 (65)

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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	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	161.7663	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	58.9003	52.3148	42.5452	32.2095	24.0770	20.3268	21.9638	28.5494	38.3189	48.6547	56.7872	60.5374 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	371.9403	375.7999	366.0739	345.3684	319.2314	294.6663	278.2553	274.3957	284.1217	304.8272	330.9643	355.5293 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727	53.8727 (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)

	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442	-107.8442 (71)

Water heating gains (Table 5)

	76.3660	74.0927	69.3721	62.9505	58.7804	52.9110	47.9255	54.3168	56.5903	63.2362	70.7367	74.1022 (72)

Total internal gains

	618.0015	613.0022	588.7860	551.3232	512.8836	478.6989	458.9394	468.0568	489.8258	527.5130	569.2829	600.9638 (73)

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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	
Northeast	0.7200	11.2829	0.4600	0.0000	0.7700	2.8774	(75)
Southeast	4.3100	36.7938	0.4600	0.0000	0.7700	56.1695	(77)
Southwest	0.7200	36.7938	0.4600	0.0000	0.7700	9.3833	(79)
Northwest	5.0600	11.2829	0.4600	0.0000	0.7700	20.2219	(81)
Southeast	3.3300	36.7938	0.4600	0.0000	0.7700	43.3978	(77)

Solar gains	132.0500	232.6026	338.6369	453.7475	539.4145	549.2286	523.8075	457.7993	378.1701	262.5704	159.5627	112.1031 (83)
Total gains	750.0514	845.6048	927.4230	1005.0707	1052.2981	1027.9275	982.7469	925.8560	867.9959	790.0833	728.8456	713.0669 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9103	36.0258	36.1397	36.6845	36.7882	37.2791	37.2791	37.3714	37.0885	36.7882	36.5790	36.3627	
alpha	3.3940	3.4017	3.4093	3.4456	3.4525	3.4853	3.4853	3.4914	3.4726	3.4525	3.4386	3.4242	
util living area	0.9799	0.9686	0.9466	0.8969	0.8035	0.6546	0.5081	0.5525	0.7609	0.9162	0.9684	0.9829	(86)
MIT	19.2810	19.4900	19.8248	20.2596	20.6302	20.8749	20.9612	20.9476	20.7763	20.3024	19.7221	19.2482	(87)
Th 2	19.8368	19.8401	19.8433	19.8584	19.8612	19.8745	19.8745	19.8769	19.8694	19.8612	19.8555	19.8495	(88)
util rest of house	0.9753	0.9615	0.9339	0.8714	0.7533	0.5677	0.3908	0.4350	0.6854	0.8901	0.9600	0.9789	(89)
MIT 2	17.5833	17.8866	18.3681	18.9878	19.4812	19.7781	19.8558	19.8494	19.6758	19.0615	18.2353	17.5439	(90)
Living area fraction									fLA = Living area / (4) =			0.1521	(91)
MIT	17.8416	18.1306	18.5897	19.1813	19.6560	19.9450	20.0239	20.0165	19.8432	19.2502	18.4615	17.8032	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6916	17.9806	18.4397	19.0313	19.5060	19.7950	19.8739	19.8665	19.6932	19.1002	18.3115	17.6532	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9452	0.9133	0.8484	0.7350	0.5610	0.3908	0.4338	0.6717	0.8672	0.9436	0.9676	(94)
Useful gains	722.0381	799.2951	847.0480	852.6518	773.4730	576.6315	384.0345	401.6604	583.0382	685.1879	687.7696	689.9748	(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	1672.8527	1628.7630	1482.0242	1238.8723	951.8357	625.1213	393.9564	416.0944	676.4953	1036.4952	1374.9206	1659.6411	(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	707.4061	557.4025	472.4223	278.0788	132.7018	0.0000	0.0000	0.0000	0.0000	261.3726	494.7487	721.4317	(98)

Space heating 3625.5644 (98)
Space heating per m2 (98) / (4) = 37.8807 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4006.1486 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	707.4061	557.4025	472.4223	278.0788	132.7018	0.0000	0.0000	0.0000	0.0000	261.3726	494.7487	721.4317	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	781.6642	615.9143	522.0136	307.2694	146.6318	0.0000	0.0000	0.0000	0.0000	288.8095	546.6837	797.1621	(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

149.2944	111.0432	87.4191	44.1241	16.9437	1.8579	0.0000	24.9387	47.5304	91.4649	126.8017	148.3200	(64)

Efficiency of water heater 87.3000 (216)

(217)m 89.9256	89.9523	89.9850	90.0480	90.1260	87.3000	87.3000	87.3000	87.3000	89.6482	89.8283	89.9378	(217)

Fuel for water heating, kWh/month

166.0200	123.4468	97.1486	49.0007	18.8000	2.1281	0.0000	28.5666	54.4449	102.0265	141.1601	164.9140	(219)

Water heating fuel used 947.6563 (219)
Annual totals kWh/year
Space heating fuel - main system 4006.1486 (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) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1029 * 1.00) = -1218.5571 -1218.5571 (233)
Total delivered energy for all uses 4276.3271 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4006.1486	3.4800	139.4140	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	947.6563	3.4800	32.9784	(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	416.0794	13.1900	54.8809	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1218.5571	13.1900	-160.7277	(252)
Total energy cost			203.0331	(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] = 0.6060 (257)
SAP value 91.5459
SAP rating (Section 12) 92 (258)
SAP band A

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	4006.1486	0.2160	865.3281	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	947.6563	0.2160	204.6938	(264)
Space and water heating			1070.0218	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)
Energy saving/generation technologies				
PV Unit	-1218.5571	0.5190	-632.4311	(269)
Total kg/year			718.4109	(272)
CO2 emissions per m2			7.5100	(273)
EI value			93.1585	
EI rating			93	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.8600	(1b)	x 2.5400	(2b) =	121.5644	(1b) - (3b)
First floor	47.8500	(1c)	x 2.6300	(2c) =	125.8455	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.7100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		247.4099	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1617	(8)
Pressure test			Yes	
Measured/design AP50			4.6500	
Infiltration rate			0.3942	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3942	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4139	0.3843	0.3942	0.3745	0.3745	0.3646	0.3548	0.3449	0.3350	0.3646	0.3449	0.3646	(22b)
Effective ac	0.5856	0.5739	0.5777	0.5701	0.5701	0.5665	0.5629	0.5595	0.5561	0.5665	0.5595	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	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			10.8100	1.2357	13.3584			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			47.8600	0.1300	6.2218	75.0000	3589.5000	(28a)
EW Brick AAC015	148.1200	16.2700	131.8500	0.2500	32.9625	52.3000	6895.7550	(29a)
Plane Ceiling	47.8600		47.8600	0.1600	7.6576	9.0000	430.7400	(30)
Total net area of external elements Aum(A, m2)			243.8400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.0843			(33)
GF Timber			73.5600			9.0000	662.0400	(32c)
1F Timber			110.7300			9.0000	996.5700	(32c)
GF Masonry			30.4300			75.0000	2282.2500	(32c)
Internal Floor			47.8600			18.0000	861.4800	(32d)
Internal Ceiling			47.8600			9.0000	430.7400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 16149.0750	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	168.7292	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.7004	(36)
Total fabric heat loss	(33) + (36) = 73.7846	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.8155	46.8522	47.1654	46.5470	46.5470	46.2497	45.9603	45.6788	45.4053	46.2497	45.6788	46.2497	(38)
Heat transfer coeff	121.6002	120.6369	120.9501	120.3316	120.3316	120.0343	119.7449	119.4635	119.1899	120.0343	119.4635	120.0343	(39)
Average = Sum(39)m / 12 =												120.1513	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2705	1.2604	1.2637	1.2573	1.2573	1.2541	1.2511	1.2482	1.2453	1.2541	1.2482	1.2541	(40)
HLP (average)												1.2554	(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	2.6961 (42)
Average daily hot water use (litres/day)	98.2325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.0557	104.1264	100.1971	96.2678	92.3385	88.4092	88.4092	92.3385	96.2678	100.1971	104.1264	108.0557	(44)
Energy conte	160.2436	140.1500	144.6223	126.0852	120.9818	104.3981	96.7401	111.0107	112.3366	130.9174	142.9066	155.1873	(45)

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

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Energy content (annual)                                                                          Total = Sum(45)m =   1545.5797 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.0365    21.0225    21.6933    18.9128    18.1473    15.6597    14.5110    16.6516    16.8505    19.6376    21.4360    23.2781 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     14.1411    12.7616    14.1037    13.6041    14.0247    13.5343    13.9618    14.0026    13.5723    14.0708    13.6558    14.1290 (61)
Total heat required for water heating calculated for each month
              174.3847   152.9117   158.7259   139.6893   135.0064   117.9324   110.7020   125.0133   125.9089   144.9882   156.5624   169.3163 (62)
Aperture area of solar collector                                                                                                     3.0000 (H1)
Zero-loss collector efficiency                                                                                                       0.7000 (H2)
Collector heat loss coefficient                                                                                                      1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                            0.0050 (H3a)
Collector effective heat loss coefficient                                                                                            1.8063 (H3b)
Collector performance ratio                                                                                                          2.5804 (H4)
Annual solar radiation per m2                                                                                                     1208.1510 (H5)
Overshading factor                                                                                                                   0.8000 (H6)
Solar energy available                                                                                                            2029.6937 (H7)
Adjustment factor for showers                                                                                                        1.0000 (H7a)
Solar-to-load ratio                                                                                                                  1.3132 (H8)
Utilisation factor                                                                                                                   0.5330 (H9)
Collector performance factor                                                                                                         0.8793 (H10)
Dedicated solar storage volume                                                                                                      75.0000 (H11)
Effective solar volume                                                                                                              75.0000 (H13)
Daily hot water demand                                                                                                              98.2325 (H14)
Volume ratio Veff/V                                                                                                                  0.7635 (H15)
Solar storage volume factor                                                                                                          0.9460 (H16)
Solar input                                                                                                                       -899.9506 (H17)
Solar input    -29.3586   -41.7460   -71.7514   -96.8092  -113.7082  -121.4583  -118.9041  -106.4227   -83.3217   -57.6057   -34.7234   -24.1413 (63)
                                                                                                  Solar input (sum of months) = Sum(63)m =   -899.9506 (63)
Output from w/h
              145.0261   111.1657    86.9746    42.8801    21.2982     0.0000     0.0000    18.5906    42.5872    87.3824   121.8389   145.1750 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =     822.9189 (64)
Heat gains from water heating, kWh/month
               56.8163    49.7903    51.6128    45.3244    43.7326    38.0959    35.6566    40.4117    40.7450    47.0477    50.9304    55.1320 (65)


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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         161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663   161.7663 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               58.9003    52.3148    42.5452    32.2095    24.0770    20.3268    21.9638    28.5494    38.3189    48.6547    56.7872    60.5374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              371.9403   375.7999   366.0739   345.3684   319.2314   294.6663   278.2553   274.3957   284.1217   304.8272   330.9643   355.5293 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727    53.8727 (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)
             -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442  -107.8442 (71)
Water heating gains (Table 5)
               76.3660    74.0927    69.3721    62.9505    58.7804    52.9110    47.9255    54.3168    56.5903    63.2362    70.7367    74.1022 (72)
Total internal gains
              618.0015   613.0022   588.7860   551.3232   512.8836   478.6989   458.9394   468.0568   489.8258   527.5130   569.2829   600.9638 (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
-------------------------------------------------------------------------------------------------------------
Northeast                              0.7200           14.6176           0.4600           0.0000           0.7700            3.7279 (75)
Southeast                              4.3100           45.1778           0.4600           0.0000           0.7700           68.9686 (77)
Southwest                              0.7200           45.1778           0.4600           0.0000           0.7700           11.5214 (79)
Northwest                              5.0600           14.6176           0.4600           0.0000           0.7700           26.1985 (81)
Southeast                              3.3300           45.1778           0.4600           0.0000           0.7700           53.2866 (77)
-------------------------------------------------------------------------------------------------------------

Solar gains    163.7030   246.0689   363.1435   492.9981   559.5471   619.8165   586.1345   523.2020   429.5280   300.2395   197.2948   136.5399 (83)
Total gains    781.7044   859.0711   951.9295  1044.3213  1072.4307  1098.5155  1045.0739   991.2588   919.3537   827.7524   766.5777   737.5037 (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, ni1,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            36.8902    37.1848    37.0885    37.2791    37.2791    37.3714    37.4617    37.5500    37.6362    37.3714    37.5500    37.3714
alpha           3.4593     3.4790     3.4726     3.4853     3.4853     3.4914     3.4974     3.5033     3.5091     3.4914     3.5033     3.4914
util living area
                0.9745     0.9640     0.9359     0.8717     0.7583     0.5718     0.4317     0.4517     0.6939     0.8853     0.9564     0.9779 (86)

MIT            19.4658    19.6295    19.9690    20.3907    20.7303    20.9278    20.9796    20.9766    20.8542    20.4598    19.9273    19.4555 (87)
Th 2           19.8640    19.8720    19.8694    19.8745    19.8745    19.8769    19.8793    19.8816    19.8839    19.8769    19.8816    19.8769 (88)
util rest of house
                0.9686     0.9559     0.9208     0.8407     0.6985     0.4768     0.3145     0.3304     0.6065     0.8499     0.9446     0.9727 (89)
MIT 2          17.8679    18.1078    18.5897    19.1764    19.6139    19.8287    19.8714    19.8725    19.7700    19.2846    18.5457    17.8618 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.1521 (91)
MIT            18.1109    18.3393    18.7995    19.3611    19.7837    19.9959    20.0400    20.0405    19.9349    19.4634    18.7559    18.1043 (92)
Temperature adjustment                                                                                                           -0.1500
adjusted MIT   17.9609    18.1893    18.6495    19.2111    19.6337    19.8459    19.8900    19.8905    19.7849    19.3134    18.6059    17.9543 (93)
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9543	0.9389	0.8995	0.8185	0.6840	0.4740	0.3156	0.3314	0.5978	0.8275	0.9259	0.9597	(94)
Useful gains	746.0157	806.5964	856.2504	854.8170	733.5476	520.7214	329.8551	328.4612	549.5789	684.9846	709.8058	707.7904	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1588.2139	1554.9197	1409.0098	1168.5528	858.4157	545.6620	334.0908	333.3598	606.0688	949.8777	1278.9617	1554.9591	(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	626.5954	502.8732	411.2529	225.8898	92.9018	0.0000	0.0000	0.0000	0.0000	197.0805	409.7923	630.2935	(98)

Space heating 3096.6795 (98)
Space heating per m2 (98) / (4) = 32.3548 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.5000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 3421.7453 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	626.5954	502.8732	411.2529	225.8898	92.9018	0.0000	0.0000	0.0000	0.0000	197.0805	409.7923	630.2935	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	692.3707	555.6610	454.4231	249.6020	102.6540	0.0000	0.0000	0.0000	0.0000	217.7685	452.8092	696.4569	(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

	145.0261	111.1657	86.9746	42.8801	21.2982	0.0000	0.0000	18.5906	42.5872	87.3824	121.8389	145.1750	(64)

Efficiency of water heater 87.3000 (216)

(217)m	89.8808	89.9034	89.9246	89.9738	89.8855	87.3000	87.3000	87.3000	87.3000	89.4923	89.7461	89.8832	(217)

Fuel for water heating, kWh/month

	161.3539	123.6501	96.7195	47.6584	23.6948	0.0000	0.0000	21.2950	48.7826	97.6424	135.7596	161.5152	(219)

Water heating fuel used 918.0716 (219)
Annual totals kWh/year
Space heating fuel - main system 3421.7453 (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) 416.0794 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.48 * 1156 * 1.00) = -1368.9771 -1368.9771 (233)
Total delivered energy for all uses 3511.9192 (238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3421.7453	10.2300	350.0445	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	918.0716	10.2300	93.9187	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	416.0794	36.7200	152.7843	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1368.9771	36.7200	-502.6884	(252)
Total energy cost			242.9592	(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	3421.7453	0.2160	739.0970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.0716	0.2160	198.3035	(264)
Space and water heating			937.4005	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	416.0794	0.5190	215.9452	(268)

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

Energy saving/generation technologies				
PV Unit	-1368.9771	0.5190	-710.4991	(269)
Total kg/year			507.7215	(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	3421.7453	1.2200	4174.5293	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	918.0716	1.2200	1120.0474	(264)
Space and water heating			5294.5767	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	416.0794	3.0700	1277.3636	(268)
Energy saving/generation technologies				
PV Unit	-1368.9771	3.0700	-4202.7598	(269)
Primary energy kWh/year			2752.9305	(272)
Primary energy kWh/m2/year			28.7632	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	168.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		326.58 (P1)
Transmission heat loss coefficient		73.78 (37)
Summer heat loss coefficient		400.37 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.7200	106.0502	0.4600	0.0000	0.9000	31.6114
South East	4.3100	127.3119	0.4600	0.0000	0.9000	227.1676
South West	0.7200	127.3119	0.4600	0.0000	0.9000	37.9491
North West	5.0600	106.0502	0.4600	0.0000	0.9000	222.1582
South East	3.3300	127.3119	0.4600	0.0000	0.9000	175.5147
total:						694.4011

	Jun	Jul	Aug	
Solar gains	746	694	618	(P4)
Internal gains	476	456	465	
Total summer gains	1222	1150	1083	(P5)
Summer gain/loss ratio	3.05	2.87	2.70	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 168.7)	0.82	0.82	0.82	
Threshold temperature	19.27	20.99	20.82	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-628.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Dawlish-As-DET
Property	6, House Sparrow Way , Botley, Southampton, SO32 2UR		

SAP Rating	90 B	**DER**	11.86	**TER**	19.42
Environmental	91 B	**% DER<TER**	38.94		
CO_2 Emissions (t/year)	0.78	**DFEE**	55.58	**TFEE**	63.26
General Requirements Compliance	Pass	**% DFEE<TFEE**	12.13		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 97 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) 19.42 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.86 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)63.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.6 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.79 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.71 m², No overhang
Windows facing East: 5.95 m², No overhang
Windows facing South: 1.31 m², No overhang
Windows facing South West: 1.03 m², No overhang
Windows facing West: 5.25 m², No overhang
Windows facing North West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.035 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.4386	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4386	(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	0.5592	0.5482	0.5373	0.4824	0.4715	0.4167	0.4167	0.4057	0.4386	0.4715	0.4934	0.5153	(22b)
Effective ac	0.6564	0.6503	0.6443	0.6164	0.6111	0.5868	0.5868	0.5823	0.5962	0.6111	0.6217	0.6328	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.3965	53.8933	53.4001	51.0835	50.6500	48.6323	48.6323	48.2587	49.4095	50.6500	51.5269	52.4436	(38)
Heat transfer coeff	139.7702	139.2670	138.7738	136.4572	136.0238	134.0061	134.0061	133.6324	134.7832	136.0238	136.9006	137.8173	(39)
Average = Sum(39)m / 12 =												136.4551	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4356	1.4304	1.4254	1.4016	1.3971	1.3764	1.3764	1.3726	1.3844	1.3971	1.4061	1.4155	(40)
HLP (average)												1.4016	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	417.8424	415.6611	400.6028	376.1820	351.1829	327.2146	311.7142	318.0311	330.6319	355.2780	383.6216	405.0753	(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	6.7100	10.6334	0.4600	0.0000	0.7700	25.2722	(74)
East	2.6200	19.6403	0.4600	0.0000	0.7700	18.2262	(76)
South	1.3100	46.7521	0.4600	0.0000	0.7700	21.6931	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	5.2500	19.6403	0.4600	0.0000	0.7700	36.5221	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	142.4186	267.4836	424.7112	612.6046	756.2628	779.2931	739.6336	629.6444	490.1480	312.1749	175.2969	118.7346	(83)
Total gains	560.2610	683.1447	825.3140	988.7867	1107.4457	1106.5077	1051.3478	947.6755	820.7799	667.4528	558.9184	523.8099	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7024	34.8278	34.9516	35.5450	35.6582	36.1951	36.1951	36.2963	35.9864	35.6582	35.4298	35.1942	
alpha	3.3135	3.3219	3.3301	3.3697	3.3772	3.4130	3.4130	3.4198	3.3991	3.3772	3.3620	3.3463	
util living area													
	0.9933	0.9865	0.9690	0.9202	0.8199	0.6669	0.5237	0.5878	0.8183	0.9566	0.9885	0.9946	(86)
MIT	18.9305	19.1722	19.5853	20.1306	20.5809	20.8588	20.9540	20.9319	20.6958	20.0887	19.4176	18.9019	(87)
Th 2	19.7361	19.7401	19.7439	19.7621	19.7655	19.7815	19.7815	19.7844	19.7753	19.7655	19.7586	19.7514	(88)
util rest of house													
	0.9915	0.9829	0.9605	0.8974	0.7679	0.5729	0.3942	0.4566	0.7447	0.9398	0.9848	0.9932	(89)
MIT 2	17.0046	17.3584	17.9577	18.7402	19.3413	19.6770	19.7610	19.7506	19.5103	18.7003	17.7292	16.9718	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.3951	17.7261	18.2877	19.0221	19.5927	19.9166	20.0029	19.9901	19.7507	18.9818	18.0715	17.3632	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2451	17.5761	18.1377	18.8721	19.4427	19.7666	19.8529	19.8401	19.6007	18.8318	17.9215	17.2132	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9857	0.9734	0.9447	0.8761	0.7518	0.5716	0.4023	0.4631	0.7319	0.9215	0.9762	0.9884	(94)
Useful gains	552.2582	664.9664	779.6689	866.2778	832.5694	632.4907	422.9956	438.9148	600.7358	615.0307	545.5957	517.7481	(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													
	1809.3339	1765.3664	1615.0117	1360.7653	1053.1848	692.3604	435.9038	459.7083	741.3999	1119.7175	1481.4687	1793.4384	(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													
	935.2643	739.4688	621.4950	356.0310	164.1379	0.0000	0.0000	0.0000	0.0000	375.4870	673.8286	949.1136	(98)

Space heating			4814.8262 (98)
Space heating per m2		(98) / (4) =	49.4538 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)			0.0000 (201)
Fraction of space heat from main system(s)			1.0000 (202)
Efficiency of main space heating system 1 (in %)			90.5000 (206)
Efficiency of secondary/supplementary heating system, %			0.0000 (208)
Space heating requirement			5320.2499 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	935.2643	739.4688	621.4950	356.0310	164.1379	0.0000	0.0000	0.0000	0.0000	375.4870	673.8286	949.1136	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1033.4412	817.0926	686.7348	393.4044	181.3678	0.0000	0.0000	0.0000	0.0000	414.9027	744.5619	1048.7443	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9800	89.9333	89.8281	89.5722	89.0242	87.3000	87.3000	87.3000	87.3000	89.5827	89.8769	89.9989	(217)
Fuel for water heating, kWh/month													
	194.5636	170.6926	177.3864	156.5533	152.2322	135.5997	127.2799	143.7432	144.7757	162.4717	174.8747	188.8670	(219)
Water heating fuel used												1929.0401	(219)
Annual totals kWh/year													
Space heating fuel - main system												5320.2499	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) =										-1264.5955		-1264.5955	(233)
Total delivered energy for all uses												6456.6581	(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	5320.2499	0.2160	1149.1740	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1929.0401	0.2160	416.6727	(264)
Space and water heating			1565.8466	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total CO2, kg/year			1154.4707	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.8600	(273)

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

DER		11.8600	ZC1
Total Floor Area	TFA	97.3600	
Assumed number of occupants	N	2.7137	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3372	ZC2
CO2 emissions from cooking, equation (L16)		1.8912	ZC3
Total CO2 emissions		29.0884	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		29.0884	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(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) =	30.0000	/ (5) =	0.1195	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3695	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.3682	(36)
Total fabric heat loss					(33) + (36) =		78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137	(42)
Average daily hot water use (litres/day)	98.6505	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.6766	47.2549	43.7846	45.2441	47.2549	47.6766	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
								Total per year (kWh/year) = Sum(64)m =				2130.2265	(64)
Heat gains from water heating, kWh/month													
	66.2474	58.3050	61.0313	54.0209	52.2113	45.8062	43.6140	48.8819	49.4300	56.4550	60.0474	64.5591	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	89.0423	86.7634	82.0313	75.0290	70.1765	63.6197	58.6210	65.7014	68.6528	75.8804	83.3992	86.7730	(72)
Total internal gains													
	430.2925	428.1065	413.0436	388.0552	362.3805	337.7448	322.2546	329.2423	342.5243	367.7381	396.0791	417.5318	(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	6.3400	10.6334	0.6300	0.7000	0.7700	20.6031	(74)
East	5.6200	19.6403	0.6300	0.7000	0.7700	33.7330	(76)
South	1.2400	46.7521	0.6300	0.7000	0.7700	17.7172	(78)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	4.9500	19.6403	0.6300	0.7000	0.7700	29.7115	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

Solar gains	116.0169	217.8883	345.9473	498.9796	615.9855	634.7428	602.4400	512.8558	399.2425	254.2882	142.7984	96.7246	(83)
Total gains	546.3094	645.9948	758.9909	887.0348	978.3661	972.4876	924.6946	842.0981	741.7668	622.0263	538.8775	514.2564	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area	0.9984	0.9964	0.9896	0.9635	0.8869	0.7338	0.5720	0.6400	0.8787	0.9825	0.9969	0.9988	(86)
MIT	19.4932	19.6619	19.9593	20.3615	20.7096	20.9179	20.9796	20.9666	20.7974	20.3379	19.8458	19.4693	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house	0.9979	0.9951	0.9856	0.9487	0.8407	0.6352	0.4344	0.5005	0.8100	0.9729	0.9955	0.9984	(89)
MIT 2	17.8210	18.0693	18.5037	19.0877	19.5552	19.7980	19.8452	19.8410	19.6805	19.0648	18.3477	17.7936	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.1601	18.3922	18.7988	19.3460	19.7893	20.0251	20.0752	20.0692	19.9070	19.3229	18.6515	18.1334	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1601	18.3922	18.7988	19.3460	19.7893	20.0251	20.0752	20.0692	19.9070	19.3229	18.6515	18.1334	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9927	0.9806	0.9404	0.8383	0.6515	0.4624	0.5285	0.8143	0.9667	0.9933	0.9974	(94)
Useful gains	544.4657	641.2480	744.2722	834.1953	820.1428	633.5922	427.5808	445.0877	603.9903	601.3432	535.2846	512.9327	(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	1790.9455	1738.5970	1580.5117	1325.2313	1023.7590	678.8163	434.8376	458.1417	729.8056	1103.9549	1469.1170	1781.1082	(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	927.3810	737.4185	622.1622	353.5460	151.4904	0.0000	0.0000	0.0000	0.0000	373.9431	672.3593	943.5226	(98)
Space heating												4781.8231	(98)
Space heating per m2											(98) / (4) =	49.1149	(99)

8c. Space cooling requirement

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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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5119.7249	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	927.3810	737.4185	622.1622	353.5460	151.4904	0.0000	0.0000	0.0000	0.0000	373.9431	672.3593	943.5226	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	992.9133	789.5273	666.1265	378.5289	162.1953	0.0000	0.0000	0.0000	0.0000	400.3674	719.8708	1010.1955	(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													
	211.8843	186.7738	196.1966	174.2983	168.7515	148.6269	142.3959	158.7381	160.4912	182.4334	192.8298	206.8066	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3336	88.1591	87.7538	86.7951	84.7808	80.3000	80.3000	80.3000	80.3000	86.8194	87.9349	88.4010	(217)
Fuel for water heating, kWh/month													
	239.8682	211.8600	223.5761	200.8158	199.0445	185.0896	177.3299	197.6813	199.8645	210.1298	219.2869	233.9414	(219)
Water heating fuel used												2498.4879	(219)
Annual totals kWh/year													
Space heating fuel - main system												5119.7249	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												398.3610	(232)
Total delivered energy for all uses												8091.5739	(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	5119.7249	0.2160	1105.8606	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2498.4879	0.2160	539.6734	(264)
Space and water heating			1645.5340	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.3610	0.5190	206.7494	(268)
Total CO2, kg/m2/year			1891.2084	(272)
Emissions per m2 for space and water heating			16.9015	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1236	(272b)
Emissions per m2 for pumps and fans			0.3998	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.9015 * 1.00) + 2.1236 + 0.3998, rounded to 2 d.p.			19.4200	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(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) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.3590	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3590	(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	0.4577	0.4487	0.4397	0.3948	0.3859	0.3410	0.3410	0.3320	0.3590	0.3859	0.4038	0.4218	(22b)
Effective ac	0.6047	0.6007	0.5967	0.5780	0.5745	0.5581	0.5581	0.5551	0.5644	0.5745	0.5815	0.5889	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.1180	49.7810	49.4506	47.8989	47.6086	46.2571	46.2571	46.0068	46.7776	47.6086	48.1959	48.8099	(38)
Heat transfer coeff	135.4917	135.1547	134.8243	133.2726	132.9823	131.6308	131.6308	131.3805	132.1513	132.9823	133.5696	134.1836	(39)
Average = Sum(39)m / 12 =												133.2712	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3917	1.3882	1.3848	1.3689	1.3659	1.3520	1.3520	1.3494	1.3573	1.3659	1.3719	1.3782	(40)
HLP (average)												1.3688	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(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	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.4777	19.9645	16.2362	12.2919	9.1883	7.7572	8.3819	10.8951	14.6234	18.5677	21.6713	23.1024	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.1344	382.7796	369.4377	347.3539	323.8733	302.0408	288.3524	292.3441	304.1161	326.3439	351.9604	372.1904	(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	6.7100	10.6334	0.4600	0.0000	0.7700	25.2722	(74)
East	2.6200	19.6403	0.4600	0.0000	0.7700	18.2262	(76)
South	1.3100	46.7521	0.4600	0.0000	0.7700	21.6931	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	5.2500	19.6403	0.4600	0.0000	0.7700	36.5221	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	142.4186	267.4836	424.7112	612.6046	756.2628	779.2931	739.6336	629.6444	490.1480	312.1749	175.2969	118.7346	(83)
Total gains	526.5530	650.2632	794.1489	959.9585	1080.1361	1081.3339	1027.9860	921.9885	794.2640	638.5187	527.2572	490.9250	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7983	35.8875	35.9755	36.3943	36.4738	36.8483	36.8483	36.9185	36.7031	36.4738	36.3134	36.1472	
alpha	3.3866	3.3925	3.3984	3.4263	3.4316	3.4566	3.4566	3.4612	3.4469	3.4316	3.4209	3.4098	
util living area													
	0.9945	0.9883	0.9717	0.9239	0.8236	0.6709	0.5267	0.5938	0.8254	0.9608	0.9903	0.9957	(86)
MIT	18.9557	19.1962	19.6069	20.1426	20.5896	20.8613	20.9553	20.9325	20.6964	20.0902	19.4244	18.9184	(87)
Th 2	19.7697	19.7724	19.7750	19.7873	19.7896	19.8003	19.8003	19.8023	19.7962	19.7896	19.7849	19.7801	(88)
util rest of house													
	0.9930	0.9852	0.9638	0.9021	0.7728	0.5780	0.3985	0.4636	0.7539	0.9455	0.9872	0.9945	(89)
MIT 2	17.9205	18.1614	18.5690	19.0961	19.5046	19.7298	19.7866	19.7791	19.6138	19.0585	18.3990	17.8909	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.1304	18.3712	18.7794	19.3083	19.7246	19.9592	20.0235	20.0129	19.8333	19.2677	18.6069	18.0992	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1304	18.3712	18.7794	19.3083	19.7246	19.9592	20.0235	20.0129	19.8333	19.2677	18.6069	18.0992	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9802	0.9554	0.8915	0.7696	0.5915	0.4238	0.4884	0.7565	0.9366	0.9829	0.9922	(94)
Useful gains	521.3910	637.4106	758.7128	855.7832	831.3082	639.6009	435.6285	450.2726	600.8602	598.0446	518.2642	487.0969	(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													
	1873.9030	1820.6921	1655.5678	1387.1403	1067.1269	705.4366	450.6405	474.6710	757.6633	1152.6493	1536.9776	1865.0447	(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													
	1006.2689	795.1652	667.2601	382.5772	175.4491	0.0000	0.0000	0.0000	0.0000	412.6259	733.4737	1025.1931	(98)
Space heating												5198.0132	(98)
Space heating per m2											(98) / (4) =	53.3896	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1237.3292	974.0677	998.4917	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8127	0.8729	0.8360	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1005.5690	850.2316	834.6970	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1367.4308	1302.8480	1180.7628	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	260.5405	336.7466	257.4729	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												854.7600	(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	65.1351	84.1867	64.3682	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												213.6900	(107)
Space cooling per m2												2.1948	(108)
Energy for space heating												53.3896	(99)
Energy for space cooling												2.1948	(108)
Total												55.5845	(109)
Dwelling Fabric Energy Efficiency (DFEE)												55.6	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1195	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3695	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3695	(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	0.4711	0.4618	0.4526	0.4064	0.3972	0.3510	0.3510	0.3417	0.3695	0.3972	0.4156	0.4341	(22b)
Effective ac	0.6109	0.6066	0.6024	0.5826	0.5789	0.5616	0.5616	0.5584	0.5682	0.5789	0.5864	0.5942	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			20.0900	1.3258	26.6345			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051			(28a)
EW Brick AAC015	147.0400	24.3500	122.6900	0.1800	22.0842			(29a)
Plane Ceiling	48.0900		48.0900	0.1300	6.2517			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.2149			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.3682	(36)
Total fabric heat loss (33) + (36) =	78.5831	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.6332	50.2762	49.9262	48.2824	47.9748	46.5431	46.5431	46.2779	47.0946	47.9748	48.5970	49.2475	(38)
Heat transfer coeff	129.2163	128.8592	128.5093	126.8654	126.5579	125.1262	125.1262	124.8610	125.6776	126.5579	127.1801	127.8305	(39)
Average = Sum(39)m / 12 =												126.8640	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3272	1.3235	1.3199	1.3031	1.2999	1.2852	1.2852	1.2825	1.2909	1.2999	1.3063	1.3130	(40)
HLP (average)												1.3030	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.1967	29.9086	30.8630	26.9071	25.8180	22.2790	20.6448	23.6902	23.9731	27.9383	30.4969	33.1176	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	135.6853	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5569	20.0348	16.2934	12.3351	9.2207	7.7845	8.4114	10.9335	14.6749	18.6331	21.7476	23.1838	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.9878	254.6027	248.0133	233.9854	216.2777	199.6350	188.5166	185.9018	192.4911	206.5190	224.2267	240.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	36.5685	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	45.9632	44.5069	41.4825	37.3710	34.7016	30.9430	27.7483	31.8416	33.2960	37.5515	42.3568	44.5130	(72)
Total internal gains													
	384.2135	382.8499	369.4949	347.3972	323.9056	302.0681	288.3820	292.3825	304.1675	326.4092	352.0367	372.2718	(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	6.3400	10.6334	0.6300	0.7000	0.7700	20.6031	(74)
East	5.6200	19.6403	0.6300	0.7000	0.7700	33.7330	(76)
South	1.2400	46.7521	0.6300	0.7000	0.7700	17.7172	(78)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	4.9500	19.6403	0.6300	0.7000	0.7700	29.7115	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	116.0169	217.8883	345.9473	498.9796	615.9855	634.7428	602.4400	512.8558	399.2425	254.2882	142.7984	96.7246	(83)
Total gains	500.2304	600.7382	715.4421	846.3768	939.8912	936.8109	890.8220	805.2382	703.4101	580.6975	494.8351	468.9964	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	52.3240	52.4690	52.6119	53.2936	53.4231	54.0344	54.0344	54.1491	53.7973	53.4231	53.1617	52.8912	
alpha	4.4883	4.4979	4.5075	4.5529	4.5615	4.6023	4.6023	4.6099	4.5865	4.5615	4.5441	4.5261	
util living area													
	0.9989	0.9973	0.9917	0.9690	0.8989	0.7517	0.5904	0.6626	0.8951	0.9865	0.9978	0.9992	(86)
MIT	19.4504	19.6203	19.9204	20.3291	20.6881	20.9091	20.9768	20.9616	20.7766	20.3020	19.8050	19.4271	(87)
Th 2	19.8196	19.8224	19.8252	19.8384	19.8409	19.8525	19.8525	19.8546	19.8480	19.8409	19.8359	19.8307	(88)
util rest of house													
	0.9985	0.9963	0.9885	0.9561	0.8557	0.6541	0.4500	0.5212	0.8318	0.9789	0.9968	0.9989	(89)
MIT 2	18.4124	18.5841	18.8847	19.2956	19.6287	19.8106	19.8467	19.8436	19.7188	19.2765	18.7793	18.3977	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	18.6229	18.7942	19.0947	19.5051	19.8435	20.0333	20.0759	20.0703	19.9333	19.4844	18.9873	18.6065	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6229	18.7942	19.0947	19.5051	19.8435	20.0333	20.0759	20.0703	19.9333	19.4844	18.9873	18.6065	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9951	0.9858	0.9513	0.8558	0.6711	0.4788	0.5501	0.8375	0.9756	0.9958	0.9985	(94)
Useful gains	499.2011	597.7936	705.2575	805.1847	804.3678	628.7255	426.5583	442.9398	589.1382	566.5552	492.7502	468.2800	(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													
	1850.7459	1790.3916	1618.5361	1345.4221	1030.6206	679.8470	434.9204	458.2782	733.1158	1124.3966	1511.8280	1841.5846	(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													
	1005.5493	801.4259	679.4793	388.9709	168.3321	0.0000	0.0000	0.0000	0.0000	415.0340	733.7360	1021.7386	(98)
Space heating												5214.2661	(98)
Space heating per m2											(98) / (4) =	53.5566	(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	1176.1858	925.9335	948.9437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8291	0.8959	0.8587	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	975.2319	829.5287	814.8736	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1198.5441	1142.5657	1044.3525	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	160.7848	232.8996	170.7323	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												564.4166 (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	40.1962	58.2249	42.6831	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												141.1041 (107)
Space cooling per m2												1.4493 (108)
Energy for space heating												53.5566 (99)
Energy for space cooling												1.4493 (108)
Total												55.0059 (109)
Target Fabric Energy Efficiency (TFEE)												63.3 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.4386	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4386	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4605	0.4276	0.4386	0.4167	0.4167	0.4057	0.3947	0.3838	0.3728	0.4057	0.3838	0.4057	(22b)
Effective ac	0.6060	0.5914	0.5962	0.5868	0.5868	0.5823	0.5779	0.5736	0.5695	0.5823	0.5736	0.5823	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.2266	49.0160	49.4095	48.6323	48.6323	48.2587	47.8950	47.5413	47.1975	48.2587	47.5413	48.2587	(38)
Heat transfer coeff	135.6003	134.3897	134.7832	134.0061	134.0061	133.6324	133.2687	132.9150	132.5712	133.6324	132.9150	133.6324	(39)
Average = Sum(39)m / 12 =												133.7794	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3928	1.3803	1.3844	1.3764	1.3764	1.3726	1.3688	1.3652	1.3617	1.3726	1.3652	1.3726	(40)
HLP (average)												1.3741	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
RHI water heating demand												1718	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	6.7100	13.4839	0.4600	0.0000	0.7700	32.0469	(74)
East	2.6200	25.1925	0.4600	0.0000	0.7700	23.3788	(76)
South	1.3100	56.7559	0.4600	0.0000	0.7700	26.3348	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	5.2500	25.1925	0.4600	0.0000	0.7700	46.8468	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	180.1365	288.7977	463.6895	673.8196	790.3140	884.1889	832.8150	726.9086	565.6402	364.1295	221.1993	147.4959	(83)
Total gains	800.3733	904.3714	1055.3669	1228.2504	1306.3687	1365.9314	1294.5179	1197.4104	1057.5806	893.5419	792.3323	750.4265	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7696	36.0918	35.9864	36.1951	36.1951	36.2963	36.3954	36.4922	36.5869	36.2963	36.4922	36.2963	
alpha	3.3846	3.4061	3.3991	3.4130	3.4130	3.4198	3.4264	3.4328	3.4391	3.4198	3.4328	3.4198	
util living area													
	0.9785	0.9673	0.9337	0.8521	0.7178	0.5214	0.3908	0.4187	0.6762	0.8896	0.9623	0.9817	(86)
MIT	19.3547	19.5445	19.9385	20.4167	20.7625	20.9416	20.9836	20.9799	20.8579	20.4239	19.8427	19.3456	(87)
Th 2	19.7689	19.7784	19.7753	19.7815	19.7815	19.7844	19.7873	19.7901	19.7928	19.7844	19.7901	19.7844	(88)
util rest of house													
	0.9731	0.9592	0.9171	0.8156	0.6505	0.4236	0.2742	0.2953	0.5813	0.8522	0.9511	0.9770	(89)
MIT 2	17.6390	17.9173	18.4750	19.1319	19.5638	19.7487	19.7818	19.7832	19.6882	19.1639	18.3582	17.6361	(90)
Living area fraction										fLA = Living area / (4) =		0.2028	(91)
MIT	17.9869	18.2472	18.7717	19.3924	19.8069	19.9906	20.0255	20.0259	19.9253	19.4193	18.6592	17.9827	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8369	18.0972	18.6217	19.2424	19.6569	19.8406	19.8755	19.8759	19.7753	19.2693	18.5092	17.8327	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9605	0.9436	0.8966	0.7964	0.6428	0.4284	0.2829	0.3044	0.5798	0.8322	0.9343	0.9658	(94)
Useful gains	768.7970	853.3381	946.2017	978.1707	839.7630	585.1445	366.2568	364.4423	613.1439	743.6038	740.3088	724.7622	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1754.2415	1719.8176	1566.4099	1305.5426	959.0640	606.7714	369.8838	368.9531	672.8428	1051.5977	1410.1236	1714.8711	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	733.1707	582.2742	461.4349	235.7077	88.7599	0.0000	0.0000	0.0000	0.0000	229.1475	482.2667	736.6410 (98)
Space heating												3549.4026 (98)
RHI space heating demand												3549 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000 / (5) =	0.1991	(8)
Pressure test		Yes	
Measured/design AP50		4.7900	
Infiltration rate		0.4386	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4386	(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	0.5592	0.5482	0.5373	0.4824	0.4715	0.4167	0.4167	0.4057	0.4386	0.4715	0.4934	0.5153	(22b)
Effective ac	0.6564	0.6503	0.6443	0.6164	0.6111	0.5868	0.5868	0.5823	0.5962	0.6111	0.6217	0.6328	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.3965	53.8933	53.4001	51.0835	50.6500	48.6323	48.6323	48.2587	49.4095	50.6500	51.5269	52.4436	(38)
Heat transfer coeff	139.7702	139.2670	138.7738	136.4572	136.0238	134.0061	134.0061	133.6324	134.7832	136.0238	136.9006	137.8173	(39)
Average = Sum(39)m / 12 =												136.4551	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4356	1.4304	1.4254	1.4016	1.3971	1.3764	1.3764	1.3726	1.3844	1.3971	1.4061	1.4155	(40)
HLP (average)												1.4016	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	6.7100	10.6334	0.4600	0.0000	0.7700	25.2722	(74)
East	2.6200	19.6403	0.4600	0.0000	0.7700	18.2262	(76)
South	1.3100	46.7521	0.4600	0.0000	0.7700	21.6931	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	5.2500	19.6403	0.4600	0.0000	0.7700	36.5221	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	142.4186	267.4836	424.7112	612.6046	756.2628	779.2931	739.6336	629.6444	490.1480	312.1749	175.2969	118.7346	(83)
Total gains	762.6554	883.0572	1016.3886	1167.0355	1272.3175	1261.0356	1201.3365	1100.1462	982.0884	841.5872	746.4299	721.6652	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7024	34.8278	34.9516	35.5450	35.6582	36.1951	36.1951	36.2963	35.9864	35.6582	35.4298	35.1942	
alpha	3.3135	3.3219	3.3301	3.3697	3.3772	3.4130	3.4130	3.4198	3.3991	3.3772	3.3620	3.3463	
util living area													
	0.9833	0.9721	0.9463	0.8833	0.7693	0.6087	0.4678	0.5223	0.7512	0.9218	0.9734	0.9860	(86)
MIT	19.1557	19.3872	19.7744	20.2725	20.6640	20.8938	20.9674	20.9526	20.7736	20.2499	19.6216	19.1247	(87)
Th 2	19.7361	19.7401	19.7439	19.7621	19.7655	19.7815	19.7815	19.7844	19.7753	19.7655	19.7586	19.7514	(88)
util rest of house													
	0.9792	0.9651	0.9327	0.8534	0.7114	0.5158	0.3481	0.3993	0.6684	0.8950	0.9656	0.9825	(89)
MIT 2	17.3307	17.6670	18.2230	18.9268	19.4354	19.7057	19.7675	19.7620	19.5883	18.9169	18.0215	17.2951	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.7007	18.0158	18.5376	19.1996	19.6845	19.9466	20.0108	20.0034	19.8286	19.1872	18.3459	17.6661	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5507	17.8658	18.3876	19.0496	19.5345	19.7966	19.8608	19.8534	19.6786	19.0372	18.1959	17.5161	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9682	0.9503	0.9128	0.8322	0.6990	0.5171	0.3563	0.4067	0.6609	0.8740	0.9511	0.9728	(94)
Useful gains	738.4091	839.1422	927.7326	971.2437	889.4062	652.0595	428.0490	447.4492	649.0390	735.5885	709.9567	702.0523	(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													
	1852.0569	1805.7023	1649.6855	1384.9903	1065.6828	696.3749	436.9627	461.4825	751.9029	1147.6587	1519.0351	1835.1850	(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													
	828.5540	649.5284	537.1330	297.8976	131.1498	0.0000	0.0000	0.0000	0.0000	306.5802	582.5364	843.0507	(98)

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Space heating			4176.4300 (98)
Space heating per m2		(98) / (4) =	42.8968 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)			0.0000 (201)
Fraction of space heat from main system(s)			1.0000 (202)
Efficiency of main space heating system 1 (in %)			90.5000 (206)
Efficiency of secondary/supplementary heating system, %			0.0000 (208)
Space heating requirement			4614.8398 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	828.5540	649.5284	537.1330	297.8976	131.1498	0.0000	0.0000	0.0000	0.0000	306.5802	582.5364	843.0507	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	915.5292	717.7109	593.5171	329.1686	144.9169	0.0000	0.0000	0.0000	0.0000	338.7627	643.6866	931.5477	(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	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9250	89.8703	89.7474	89.4506	88.8450	87.3000	87.3000	87.3000	87.3000	89.4446	89.8006	89.9468	(217)
Fuel for water heating, kWh/month	194.6824	170.8123	177.5460	156.7663	152.5393	135.5997	127.2799	143.7432	144.7757	162.7227	175.0233	188.9765	(219)
Water heating fuel used												1930.4673	(219)
Annual totals kWh/year													
Space heating fuel - main system												4614.8398	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) =										-1264.5955		-1264.5955	(233)
Total delivered energy for all uses												5752.6752	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4614.8398	3.4800	160.5964	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1930.4673	3.4800	67.1803	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1264.5955	13.1900	-166.8001	(252)
Total energy cost			243.2285	(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] =		0.7176 (257)
SAP value			89.9896
SAP rating (Section 12)			90 (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	4614.8398	0.2160	996.8054	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1930.4673	0.2160	416.9809	(264)
Space and water heating			1413.7863	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total kg/year			1002.4104	(272)
CO2 emissions per m2			10.3000	(273)
EI value			90.5646	
EI rating			91	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8885 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8885 = 0.2431, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =			50.0000 / (5) =	0.1991	(8)
Pressure test				Yes	
Measured/design AP50				4.7900	
Infiltration rate				0.4386	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4386	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4605	0.4276	0.4386	0.4167	0.4167	0.4057	0.3947	0.3838	0.3728	0.4057	0.3838	0.4057	(22b)
Effective ac	0.6060	0.5914	0.5962	0.5868	0.5868	0.5823	0.5779	0.5736	0.5695	0.5823	0.5736	0.5823	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17461.3200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		179.3480 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6864 (36)
Total fabric heat loss	(33) + (36) =	85.3737 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.2266	49.0160	49.4095	48.6323	48.6323	48.2587	47.8950	47.5413	47.1975	48.2587	47.5413	48.2587	(38)
Heat transfer coeff	135.6003	134.3897	134.7832	134.0061	134.0061	133.6324	133.2687	132.9150	132.5712	133.6324	132.9150	133.6324	(39)
Average = Sum(39)m / 12 =												133.7794	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3928	1.3803	1.3844	1.3764	1.3764	1.3726	1.3688	1.3652	1.3617	1.3726	1.3652	1.3726	(40)
HLP (average)												1.3741	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
									Total per year (kWh/year) = Sum(64)m =			1717.7401	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	6.7100	13.4839	0.4600	0.0000	0.7700	32.0469	(74)
East	2.6200	25.1925	0.4600	0.0000	0.7700	23.3788	(76)
South	1.3100	56.7559	0.4600	0.0000	0.7700	26.3348	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	5.2500	25.1925	0.4600	0.0000	0.7700	46.8468	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	180.1365	288.7977	463.6895	673.8196	790.3140	884.1889	832.8150	726.9086	565.6402	364.1295	221.1993	147.4959	(83)
Total gains	800.3733	904.3714	1055.3669	1228.2504	1306.3687	1365.9314	1294.5179	1197.4104	1057.5806	893.5419	792.3323	750.4265	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7696	36.0918	35.9864	36.1951	36.1951	36.2963	36.3954	36.4922	36.5869	36.2963	36.4922	36.2963	
alpha	3.3846	3.4061	3.3991	3.4130	3.4130	3.4198	3.4264	3.4328	3.4391	3.4198	3.4328	3.4198	
util living area													
	0.9785	0.9673	0.9337	0.8521	0.7178	0.5214	0.3908	0.4187	0.6762	0.8896	0.9623	0.9817	(86)
MIT	19.3547	19.5445	19.9385	20.4167	20.7625	20.9416	20.9836	20.9799	20.8579	20.4239	19.8427	19.3456	(87)
Th 2	19.7689	19.7784	19.7753	19.7815	19.7815	19.7844	19.7873	19.7901	19.7928	19.7844	19.7901	19.7844	(88)
util rest of house													
	0.9731	0.9592	0.9171	0.8156	0.6505	0.4236	0.2742	0.2953	0.5813	0.8522	0.9511	0.9770	(89)
MIT 2	17.6390	17.9173	18.4750	19.1319	19.5638	19.7487	19.7818	19.7832	19.6882	19.1639	18.3582	17.6361	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)
MIT	17.9869	18.2472	18.7717	19.3924	19.8069	19.9906	20.0255	20.0259	19.9253	19.4193	18.6592	17.9827	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8369	18.0972	18.6217	19.2424	19.6569	19.8406	19.8755	19.8759	19.7753	19.2693	18.5092	17.8327	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9605	0.9436	0.8966	0.7964	0.6428	0.4284	0.2829	0.3044	0.5798	0.8322	0.9343	0.9658	(94)
Useful gains	768.7970	853.3381	946.2017	978.1707	839.7630	585.1445	366.2568	364.4423	613.1439	743.6038	740.3088	724.7622	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1754.2415	1719.8176	1566.4099	1305.5426	959.0640	606.7714	369.8838	368.9531	672.8428	1051.5977	1410.1236	1714.8711	(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													
	733.1707	582.2742	461.4349	235.7077	88.7599	0.0000	0.0000	0.0000	0.0000	229.1475	482.2667	736.6410	(98)

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

Space heating		3549.4026 (98)
Space heating per m2	(98) / (4) =	36.4565 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		90.5000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		3921.9918 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	733.1707	582.2742	461.4349	235.7077	88.7599	0.0000	0.0000	0.0000	0.0000	229.1475	482.2667	736.6410	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	810.1333	643.3969	509.8728	260.4505	98.0773	0.0000	0.0000	0.0000	0.0000	253.2016	532.8914	813.9679	(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													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8651	89.8132	89.6564	89.2793	88.5390	87.3000	87.3000	87.3000	87.3000	89.2295	89.6919	89.8823	(217)
Fuel for water heating, kWh/month													
	194.8123	170.9209	177.7260	157.0670	153.0666	135.5997	127.2799	143.7432	144.7757	163.1149	175.2354	189.1121	(219)
Water heating fuel used												1932.4537	(219)
Annual totals kWh/year													
Space heating fuel - main system												3921.9918	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1187 * 1.00) =										-1404.8611		-1404.8611	(233)
Total delivered energy for all uses												4921.5480	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3921.9918	10.2300	401.2198	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1932.4537	10.2300	197.6900	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1404.8611	36.7200	-515.8650	(252)
Total energy cost			359.3498	(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	3921.9918	0.2160	847.1502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.4537	0.2160	417.4100	(264)
Space and water heating			1264.5602	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	0.5190	-729.1229	(269)
Total kg/year			780.3864	(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	3921.9918	1.2200	4784.8300	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1932.4537	1.2200	2357.5935	(264)
Space and water heating			7142.4235	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)

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

Energy saving/generation technologies			
PV Unit	-1404.8611	3.0700	-4312.9235 (269)
Primary energy kWh/year			4278.4281 (272)
Primary energy kWh/m2/year			43.9444 (273)

SAP 2012 EPC IMPROVEMENTS

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

(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	+ 1.1	-£ 85	-192 kg (24.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.97 kg/m²	B 91	A 92
Total Savings	£85	1.97 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£173	£192	-£18
Mains gas	£702	£599	£103
Space heating	£532	£532	£0
Water heating	£198	£113	£85
Lighting	£146	£146	£0
Generated (PV)	-£516	-£516	£0
Total cost of fuels	£359	£275	£85
Total cost of uses	£360	£275	£85
Delivered energy	51 kWh/m²	41 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	44 kWh/m²	33 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700 (1b)	x	2.5400 (2b)	=	125.1458	(1b) - (3b)
First floor	48.0900 (1c)	x	2.6200 (2c)	=	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.4386	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4386	(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	0.5592	0.5482	0.5373	0.4824	0.4715	0.4167	0.4167	0.4057	0.4386	0.4715	0.4934	0.5153	(22b)
Effective ac	0.6564	0.6503	0.6443	0.6164	0.6111	0.5868	0.5868	0.5823	0.5962	0.6111	0.6217	0.6328	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(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	54.3965	53.8933	53.4001	51.0835	50.6500	48.6323	48.6323	48.2587	49.4095	50.6500	51.5269	52.4436	(38)
Heat transfer coeff	139.7702	139.2670	138.7738	136.4572	136.0238	134.0061	134.0061	133.6324	134.7832	136.0238	136.9006	137.8173	(39)
Average = Sum(39)m / 12 =												136.4551	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4356	1.4304	1.4254	1.4016	1.3971	1.3764	1.3764	1.3726	1.3844	1.3971	1.4061	1.4155	(40)
HLP (average)												1.4016	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(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												1.1684	(H8)
Utilisation factor												0.5751	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-866.7922	(H17)
Solar input	-25.1352	-41.9435	-71.4346	-95.7364	-118.2743	-116.2825	-114.7457	-100.2539	-78.5189	-53.6192	-29.8140	-21.0339	(63)
								Solar input (sum of months) = Sum(63)m =				-866.7922	(63)
Output from w/h													
	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
								Total per year (kWh/year) = Sum(64)m =				854.5783	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(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	6.7100	10.6334	0.4600	0.0000	0.7700	25.2722	(74)
East	2.6200	19.6403	0.4600	0.0000	0.7700	18.2262	(76)
South	1.3100	46.7521	0.4600	0.0000	0.7700	21.6931	(78)
Southwest	1.0300	36.7938	0.4600	0.0000	0.7700	13.4233	(79)
West	5.2500	19.6403	0.4600	0.0000	0.7700	36.5221	(80)
Northwest	1.0300	11.2829	0.4600	0.0000	0.7700	4.1163	(81)
East	3.3300	19.6403	0.4600	0.0000	0.7700	23.1654	(76)

Solar gains	142.4186	267.4836	424.7112	612.6046	756.2628	779.2931	739.6336	629.6444	490.1480	312.1749	175.2969	118.7346	(83)
Total gains	762.6554	883.0572	1016.3886	1167.0355	1272.3175	1261.0356	1201.3365	1100.1462	982.0884	841.5872	746.4299	721.6652	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.7024	34.8278	34.9516	35.5450	35.6582	36.1951	36.1951	36.2963	35.9864	35.6582	35.4298	35.1942	
alpha	3.3135	3.3219	3.3301	3.3697	3.3772	3.4130	3.4130	3.4198	3.3991	3.3772	3.3620	3.3463	
util living area													
	0.9833	0.9721	0.9463	0.8833	0.7693	0.6087	0.4678	0.5223	0.7512	0.9218	0.9734	0.9860	(86)
MIT	19.1557	19.3872	19.7744	20.2725	20.6640	20.8938	20.9674	20.9526	20.7736	20.2499	19.6216	19.1247	(87)
Th 2	19.7361	19.7401	19.7439	19.7621	19.7655	19.7815	19.7815	19.7844	19.7753	19.7655	19.7586	19.7514	(88)
util rest of house													
	0.9792	0.9651	0.9327	0.8534	0.7114	0.5158	0.3481	0.3993	0.6684	0.8950	0.9656	0.9825	(89)
MIT 2	17.3307	17.6670	18.2230	18.9268	19.4354	19.7057	19.7675	19.7620	19.5883	18.9169	18.0215	17.2951	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	17.7007	18.0158	18.5376	19.1996	19.6845	19.9466	20.0108	20.0034	19.8286	19.1872	18.3459	17.6661	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5507	17.8658	18.3876	19.0496	19.5345	19.7966	19.8608	19.8534	19.6786	19.0372	18.1959	17.5161	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9682	0.9503	0.9128	0.8322	0.6990	0.5171	0.3563	0.4067	0.6609	0.8740	0.9511	0.9728	(94)
Useful gains	738.4091	839.1422	927.7326	971.2437	889.4062	652.0595	428.0490	447.4492	649.0390	735.5885	709.9567	702.0523	(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	1852.0569	1805.7023	1649.6855	1384.9903	1065.6828	696.3749	436.9627	461.4825	751.9029	1147.6587	1519.0351	1835.1850	(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	828.5540	649.5284	537.1330	297.8976	131.1498	0.0000	0.0000	0.0000	0.0000	306.5802	582.5364	843.0507	(98)
Space heating												4176.4300	(98)
Space heating per m2											(98) / (4) =	42.8968	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4614.8398	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	828.5540	649.5284	537.1330	297.8976	131.1498	0.0000	0.0000	0.0000	0.0000	306.5802	582.5364	843.0507	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	915.5292	717.7109	593.5171	329.1686	144.9169	0.0000	0.0000	0.0000	0.0000	338.7627	643.6866	931.5477	(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	149.9330	111.5660	87.9082	44.4919	17.2493	2.0961	0.0000	25.2339	47.8702	91.9274	127.3579	148.9444	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9945	90.0163	90.0358	90.0710	90.1160	87.3000	87.3000	87.3000	87.3000	89.7412	89.9088	90.0046	(217)
Fuel for water heating, kWh/month	166.6023	123.9397	97.6370	49.3965	19.1412	2.4010	0.0000	28.9048	54.8342	102.4362	141.6524	165.4852	(219)
Water heating fuel used												952.4304	(219)
Annual totals kWh/year													
Space heating fuel - main system												4614.8398	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1068 * 1.00) =										-1264.5955		-1264.5955	(233)
Total delivered energy for all uses												4824.6383	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4614.8398	3.4800	160.5964	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	952.4304	3.4800	33.1446	(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	396.9635	13.1900	52.3595	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1264.5955	13.1900	-166.8001	(252)
Total energy cost			215.7879	(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] =	0.6366	(257)
SAP value		91.1190	
SAP rating (Section 12)		91	(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	4614.8398	0.2160	996.8054	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	952.4304	0.2160	205.7250	(264)
Space and water heating			1202.5304	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	396.9635	0.5190	206.0241	(268)
Energy saving/generation technologies				
PV Unit	-1264.5955	0.5190	-656.3250	(269)
Total kg/year			817.1044	(272)
CO2 emissions per m2			8.3900	(273)
EI value			92.3088	
EI rating			92	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.2700	(1b)	x 2.5400	(2b) =	125.1458	(1b) - (3b)
First floor	48.0900	(1c)	x 2.6200	(2c) =	125.9958	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	97.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.1416	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1991	(8)
Pressure test			Yes	
Measured/design AP50			4.7900	
Infiltration rate			0.4386	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4386	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4605	0.4276	0.4386	0.4167	0.4167	0.4057	0.3947	0.3838	0.3728	0.4057	0.3838	0.4057	(22b)
Effective ac	0.6060	0.5914	0.5962	0.5868	0.5868	0.5823	0.5779	0.5736	0.5695	0.5823	0.5736	0.5823	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			17.9500	1.2357	22.1816			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			49.2700	0.1300	6.4051	75.0000	3695.2500	(28a)
EW Brick AAC015	147.0400	25.5400	121.5000	0.2500	30.3750	52.3000	6354.4500	(29a)
Plane Ceiling	48.0900		48.0900	0.1600	7.6944	9.0000	432.8100	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			245.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.6873			(33)
GF Timber			28.5500			9.0000	256.9500	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			58.4200			75.0000	4381.5000	(32c)
Internal Floor			48.0900			18.0000	865.6200	(32d)
Internal Ceiling			48.0900			9.0000	432.8100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 17461.3200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	179.3480	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6864	(36)
Total fabric heat loss	(33) + (36) = 85.3737	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	50.2266	49.0160	49.4095	48.6323	48.6323	48.2587	47.8950	47.5413	47.1975	48.2587	47.5413	48.2587	(38)
Heat transfer coeff	135.6003	134.3897	134.7832	134.0061	134.0061	133.6324	133.2687	132.9150	132.5712	133.6324	132.9150	133.6324	(39)
Average = Sum(39)m / 12 =												133.7794	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3928	1.3803	1.3844	1.3764	1.3764	1.3726	1.3688	1.3652	1.3617	1.3726	1.3652	1.3726	(40)
HLP (average)												1.3741	(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	2.7137 (42)
Average daily hot water use (litres/day)	98.6505 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.5156	104.5695	100.6235	96.6775	92.7315	88.7855	88.7855	92.7315	96.6775	100.6235	104.5695	108.5156	(44)
Energy conte	160.9254	140.7464	145.2377	126.6217	121.4966	104.8423	97.1518	111.4831	112.8146	131.4745	143.5147	155.8477	(45)
Energy content (annual)										Total = Sum(45)m =		1552.1566	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.1388	21.1120	21.7857	18.9933	18.2245	15.7263	14.5728	16.7225	16.9222	19.7212	21.5272	23.3772	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1428	12.7631	14.1051	13.6066	14.0270	13.5362	13.9636	14.0047	13.5746	14.0721	13.6572	14.1306	(61)
Total heat required for water heating calculated for each month													
	175.0682	153.5095	159.3428	140.2283	135.5235	118.3785	111.1154	125.4878	126.3891	145.5466	157.1720	169.9783	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3077	(H8)
Utilisation factor												0.5345	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.6505	(H14)
Volume ratio Veff/V												0.7603	(H15)
Solar storage volume factor												0.9452	(H16)
Solar input												-901.6911	(H17)
Solar input	-29.4153	-41.8267	-71.8901	-96.9964	-113.9281	-121.6932	-119.1340	-106.6286	-83.4828	-57.7171	-34.7906	-24.1880	(63)
										Solar input (sum of months) = Sum(63)m =		-901.6911	(63)
Output from w/h													
	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
										Total per year (kWh/year) = Sum(64)m =		827.3824	(64)
Heat gains from water heating, kWh/month													
	57.0434	49.9890	51.8178	45.5034	43.9044	38.2441	35.7939	40.5693	40.9045	47.2333	51.1330	55.3520	(65)

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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	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	162.8223	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.1943	49.9113	40.5906	30.7297	22.9708	19.3929	20.9547	27.2377	36.5584	46.4193	54.1782	57.7561	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	376.1012	380.0040	370.1692	349.2320	322.8026	297.9627	281.3681	277.4654	287.3002	308.2373	334.6667	359.5066	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	53.9959	(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)													
	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	-108.5482	(71)
Water heating gains (Table 5)													
	76.6712	74.3883	69.6476	63.1991	59.0112	53.1168	48.1100	54.5286	56.8118	63.4856	71.0180	74.3979	(72)
Total internal gains													
	620.2368	615.5736	591.6774	554.4309	516.0547	481.7425	461.7029	470.5018	491.9405	529.4124	571.1330	602.9307	(73)

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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	6.7100	13.4839	0.4600	0.0000	0.7700	32.0469	(74)
East	2.6200	25.1925	0.4600	0.0000	0.7700	23.3788	(76)
South	1.3100	56.7559	0.4600	0.0000	0.7700	26.3348	(78)
Southwest	1.0300	45.1778	0.4600	0.0000	0.7700	16.4820	(79)
West	5.2500	25.1925	0.4600	0.0000	0.7700	46.8468	(80)
Northwest	1.0300	14.6176	0.4600	0.0000	0.7700	5.3329	(81)
East	3.3300	25.1925	0.4600	0.0000	0.7700	29.7142	(76)

Solar gains	180.1365	288.7977	463.6895	673.8196	790.3140	884.1889	832.8150	726.9086	565.6402	364.1295	221.1993	147.4959	(83)
Total gains	800.3733	904.3714	1055.3669	1228.2504	1306.3687	1365.9314	1294.5179	1197.4104	1057.5806	893.5419	792.3323	750.4265	(84)

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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, n1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7696	36.0918	35.9864	36.1951	36.1951	36.2963	36.3954	36.4922	36.5869	36.2963	36.4922	36.2963	
alpha	3.3846	3.4061	3.3991	3.4130	3.4130	3.4198	3.4264	3.4328	3.4391	3.4198	3.4328	3.4198	
util living area													
	0.9785	0.9673	0.9337	0.8521	0.7178	0.5214	0.3908	0.4187	0.6762	0.8896	0.9623	0.9817	(86)
MIT	19.3547	19.5445	19.9385	20.4167	20.7625	20.9416	20.9836	20.9799	20.8579	20.4239	19.8427	19.3456	(87)
Th 2	19.7689	19.7784	19.7753	19.7815	19.7815	19.7844	19.7873	19.7901	19.7928	19.7844	19.7901	19.7844	(88)
util rest of house													
	0.9731	0.9592	0.9171	0.8156	0.6505	0.4236	0.2742	0.2953	0.5813	0.8522	0.9511	0.9770	(89)
MIT 2	17.6390	17.9173	18.4750	19.1319	19.5638	19.7487	19.7818	19.7832	19.6882	19.1639	18.3582	17.6361	(90)
Living area fraction									fLA = Living area / (4) =			0.2028	(91)

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

MIT	17.9869	18.2472	18.7717	19.3924	19.8069	19.9906	20.0255	20.0259	19.9253	19.4193	18.6592	17.9827	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8369	18.0972	18.6217	19.2424	19.6569	19.8406	19.8755	19.8759	19.7753	19.2693	18.5092	17.8327	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9605	0.9436	0.8966	0.7964	0.6428	0.4284	0.2829	0.3044	0.5798	0.8322	0.9343	0.9658	(94)
Useful gains	768.7970	853.3381	946.2017	978.1707	839.7630	585.1445	366.2568	364.4423	613.1439	743.6038	740.3088	724.7622	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1754.2415	1719.8176	1566.4099	1305.5426	959.0640	606.7714	369.8838	368.9531	672.8428	1051.5977	1410.1236	1714.8711	(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	733.1707	582.2742	461.4349	235.7077	88.7599	0.0000	0.0000	0.0000	0.0000	229.1475	482.2667	736.6410	(98)
Space heating												3549.4026	(98)
Space heating per m2											(98) / (4) =	36.4565	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3921.9918	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	733.1707	582.2742	461.4349	235.7077	88.7599	0.0000	0.0000	0.0000	0.0000	229.1475	482.2667	736.6410	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	810.1333	643.3969	509.8728	260.4505	98.0773	0.0000	0.0000	0.0000	0.0000	253.2016	532.8914	813.9679	(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	145.6529	111.6827	87.4527	43.2319	21.5954	0.0000	0.0000	18.8592	42.9063	87.8295	122.3814	145.7903	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9535	89.9693	89.9745	89.9888	89.8555	87.3000	87.3000	87.3000	87.3000	89.5901	89.8335	89.9552	(217)
Fuel for water heating, kWh/month	161.9201	124.1343	97.1972	48.0414	24.0335	0.0000	0.0000	21.6028	49.1482	98.0348	136.2313	162.0699	(219)
Water heating fuel used												922.4135	(219)
Annual totals kWh/year													
Space heating fuel - main system												3921.9918	(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)												396.9635	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1187 * 1.00) =										-1404.8611		-1404.8611	(233)
Total delivered energy for all uses												3961.5078	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3921.9918	10.2300	401.2198	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	922.4135	10.2300	94.3629	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	396.9635	36.7200	145.7650	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1404.8611	36.7200	-515.8650	(252)
Total energy cost			274.3827	(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	3921.9918	0.2160	847.1502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.4135	0.2160	199.2413	(264)

Space and water heating			1046.3916 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	396.9635	0.5190	206.0241 (268)
Energy saving/generation technologies			
PV Unit	-1404.8611	0.5190	-729.1229 (269)
Total kg/year			588.1677 (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	3921.9918	1.2200	4784.8300	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	922.4135	1.2200	1125.3445	(264)
Space and water heating			5910.1745	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	396.9635	3.0700	1218.6781	(268)
Energy saving/generation technologies				
PV Unit	-1404.8611	3.0700	-4312.9235	(269)
Primary energy kWh/year			3199.6791	(272)
Primary energy kWh/m2/year			32.8644	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	179.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		331.51 (P1)
Transmission heat loss coefficient		85.37 (37)
Summer heat loss coefficient		416.88 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.7100	87.1704	0.4600	0.0000	0.9000	242.1543
East	2.6200	125.2818	0.4600	0.0000	0.9000	135.8906
South	1.3100	118.5567	0.4600	0.0000	0.9000	64.2980
South West	1.0300	127.3119	0.4600	0.0000	0.9000	54.2883
West	5.2500	125.2818	0.4600	0.0000	0.9000	272.3000
North West	1.0300	106.0502	0.4600	0.0000	0.9000	45.2219
East	3.3300	125.2818	0.4600	0.0000	0.9000	172.7160
total:						986.8691

	Jun	Jul	Aug	
Solar gains	1065	987	859	(P4)
Internal gains	479	459	468	
Total summer gains	1544	1446	1326	(P5)
Summer gain/loss ratio	3.70	3.47	3.18	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 179.3)	0.74	0.74	0.74	
Threshold temperature	19.85	21.51	21.23	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-629.R	**Issued on Date**	05/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Islington-As-DET
Property	8, House Sparrow Way , Botley, Southampton, SO32 2UR		

SAP Rating	90 B	**DER**	11.43	**TER**	18.72
Environmental	91 B	**% DER<TER**	38.94		
CO_2 Emissions (t/year)	0.79	**DFEE**	51.54	**TFEE**	59.48
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.34		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 101 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.72 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.43 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 4.44 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.68 m², No overhang
Windows facing South: 8.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.029 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.4400	
Infiltration rate		0.4139	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4139	(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	0.5278	0.5174	0.5071	0.4553	0.4450	0.3932	0.3932	0.3829	0.4139	0.4450	0.4657	0.4864	(22b)
Effective ac	0.6393	0.6339	0.6286	0.6037	0.5990	0.5773	0.5773	0.5733	0.5857	0.5990	0.6084	0.6183	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639 (36)
Total fabric heat loss	(33) + (36) =	79.5270 (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	54.9577	54.4928	54.0371	51.8967	51.4962	49.6320	49.6320	49.2868	50.3501	51.4962	52.3064	53.1533	(38)
Heat transfer coeff	134.4847	134.0198	133.5641	131.4236	131.0232	129.1589	129.1589	128.8137	129.8770	131.0232	131.8333	132.6803	(39)
Average = Sum(39)m / 12 =												131.4217	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3344	1.3298	1.3253	1.3041	1.3001	1.2816	1.2816	1.2782	1.2887	1.3001	1.3081	1.3165	(40)
HLP (average)												1.3040	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(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	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.9855	21.3037	17.3254	13.1164	9.8047	8.2775	8.9441	11.6259	15.6043	19.8133	23.1250	24.6522	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	426.0099	423.7000	408.2077	383.1607	357.5269	333.0462	317.3011	323.7796	336.7949	362.0692	391.0739	413.0199	(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	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
South	5.0200	46.7521	0.4600	0.0000	0.7700	83.1291	(78)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	167.1981	281.7329	382.3943	476.9036	542.9851	544.5336	522.5922	471.3981	414.2695	310.0542	199.5835	143.5939	(83)
Total gains	593.2080	705.4330	790.6021	860.0642	900.5120	877.5798	839.8933	795.1777	751.0644	672.1234	590.6573	556.6139	(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	33.1103	33.2251	33.3385	33.8814	33.9850	34.4755	34.4755	34.5679	34.2849	33.9850	33.7761	33.5605	
alpha	3.2074	3.2150	3.2226	3.2588	3.2657	3.2984	3.2984	3.3045	3.2857	3.2657	3.2517	3.2374	
util living area													
	0.9897	0.9813	0.9663	0.9332	0.8659	0.7439	0.6025	0.6451	0.8293	0.9470	0.9828	0.9916	(86)
MIT	18.9279	19.1674	19.5318	20.0088	20.4473	20.7801	20.9212	20.8992	20.6548	20.0853	19.4260	18.8959	(87)
Th 2	19.8140	19.8175	19.8211	19.8377	19.8408	19.8553	19.8553	19.8580	19.8497	19.8408	19.8345	19.8279	(88)
util rest of house													
	0.9873	0.9770	0.9579	0.9152	0.8258	0.6611	0.4737	0.5206	0.7645	0.9292	0.9780	0.9896	(89)
MIT 2	17.0683	17.4181	17.9473	18.6389	19.2448	19.6726	19.8134	19.7996	19.5303	18.7591	17.8069	17.0299	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.3918	17.7223	18.2229	18.8772	19.4540	19.8652	20.0061	19.9909	19.7259	18.9898	18.0885	17.3544	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2418	17.5723	18.0729	18.7272	19.3040	19.7152	19.8561	19.8409	19.5759	18.8398	17.9385	17.2044	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9789	0.9644	0.9402	0.8921	0.8027	0.6493	0.4738	0.5185	0.7453	0.9074	0.9660	0.9825	(94)
Useful gains	580.6878	680.3473	743.2977	767.2580	722.8284	569.8563	397.9550	412.2993	559.7979	609.9117	570.5936	546.8561	(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													
	1740.4692	1698.3450	1545.7285	1291.5206	996.2980	660.6760	420.5563	443.2331	711.1971	1079.6056	1428.8757	1725.4324	(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													
	862.8774	684.0945	597.0085	377.4691	203.4614	0.0000	0.0000	0.0000	0.0000	349.4523	617.9631	876.8608	(98)
Space heating												4569.1871	(98)
Space heating per m2											(98) / (4) =	45.3382	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5048.8255	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	862.8774	684.0945	597.0085	377.4691	203.4614	0.0000	0.0000	0.0000	0.0000	349.4523	617.9631	876.8608	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	953.4557	755.9055	659.6779	417.0930	224.8192	0.0000	0.0000	0.0000	0.0000	386.1351	682.8322	968.9069	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9406	89.8925	89.8026	89.6057	89.1874	87.3000	87.3000	87.3000	87.3000	89.5302	89.8285	89.9613	(217)
Fuel for water heating, kWh/month													
	196.0704	172.0141	178.7219	157.6203	153.0383	136.5557	128.1658	144.7599	145.8047	163.7339	176.2384	190.3225	(219)
Water heating fuel used												1943.0458	(219)
Annual totals kWh/year													
Space heating fuel - main system												5048.8255	(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)												423.5919	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												6301.7317	(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	5048.8255	0.2160	1090.5463	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1943.0458	0.2160	419.6979	(264)
Space and water heating			1510.2442	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total CO2, kg/year			1152.0617	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.4300	(273)

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

DER		11.4300	ZC1
Total Floor Area	TFA	100.7800	
Assumed number of occupants	N	2.7466	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1457	ZC2
CO2 emissions from cooking, equation (L16)		1.8349	ZC3
Total CO2 emissions		28.4105	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.4105	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900	(1b)	x 2.5400	(2b) =	127.9906	(1b) - (3b)
First floor	50.3900	(1c)	x 2.6300	(2c) =	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.4035	(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	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			16.0300	1.3258	21.2519			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.1800	23.1768			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	62.2161			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.1458	(36)
Total fabric heat loss					(33) + (36) =		73.3619	(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	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	127.7264	127.2845	126.8514	124.8170	124.4364	122.6645	122.6645	122.3364	123.3470	124.4364	125.2064	126.0114	(39)
Average = Sum(39)m / 12 =												124.8152	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2674	1.2630	1.2587	1.2385	1.2347	1.2172	1.2172	1.2139	1.2239	1.2347	1.2424	1.2504	(40)
HLP (average)												1.2385	(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	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0545	47.6295	44.1317	45.6027	47.6295	48.0545	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (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												
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419 (64)
								Total per year (kWh/year) = Sum(64)m =				2144.7403 (64)
Heat gains from water heating, kWh/month												
	66.6716	58.6760	61.4140	54.4491	52.6252	46.1693	43.9597	49.2693	49.8218	56.8015	60.4257	64.9698 (65)

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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	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.9855	21.3037	17.3254	13.1164	9.8047	8.2775	8.9441	11.6259	15.6043	19.8133	23.1250	24.6522	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	89.6123	87.3154	82.5458	75.6237	70.7328	64.1240	59.0856	66.2222	69.1969	76.3461	83.9245	87.3250	(72)
Total internal gains													
	438.3799	436.0741	420.5905	395.1201	368.8166	343.6684	327.9314	335.0769	348.7656	374.4631	403.4541	425.3940	(73)

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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	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
South	8.3500	46.7521	0.6300	0.7000	0.7700	119.3051	(78)

Solar gains	144.2628	243.0865	329.9398	411.4848	468.5017	469.8378	450.9062	406.7346	357.4426	267.5228	172.2058	123.8966	(83)
Total gains	582.6427	679.1607	750.5303	806.6049	837.3183	813.5062	778.8376	741.8115	706.2082	641.9859	575.6599	549.2906	(84)

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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	54.7938	54.9840	55.1717	56.0710	56.2425	57.0549	57.0549	57.2079	56.7392	56.2425	55.8966	55.5395	
alpha	4.6529	4.6656	4.6781	4.7381	4.7495	4.8037	4.8037	4.8139	4.7826	4.7495	4.7264	4.7026	
util living area	0.9983	0.9961	0.9910	0.9755	0.9296	0.8126	0.6515	0.6980	0.8944	0.9816	0.9964	0.9987	(86)
MIT	19.5845	19.7465	19.9989	20.3365	20.6523	20.8859	20.9703	20.9586	20.7982	20.3907	19.9307	19.5646	(87)
Th 2	19.8665	19.8699	19.8733	19.8893	19.8923	19.9063	19.9063	19.9089	19.9009	19.8923	19.8863	19.8799	(88)
util rest of house	0.9977	0.9948	0.9876	0.9650	0.8964	0.7246	0.5096	0.5604	0.8324	0.9719	0.9949	0.9982	(89)
MIT 2	17.9863	18.2252	18.5949	19.0925	19.5310	19.8235	19.8946	19.8906	19.7290	19.1767	18.5061	17.9665	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.2643	18.4898	18.8391	19.3088	19.7260	20.0083	20.0817	20.0764	19.9150	19.3879	18.7539	18.2445	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2643	18.4898	18.8391	19.3088	19.7260	20.0083	20.0817	20.0764	19.9150	19.3879	18.7539	18.2445	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9922	0.9830	0.9576	0.8902	0.7341	0.5341	0.5836	0.8334	0.9655	0.9925	0.9972	(94)
Useful gains	580.4871	673.8726	737.7887	772.4262	745.3610	597.1837	415.9837	432.9141	588.5721	619.8234	571.3425	547.7436	(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	1783.6105	1729.7730	1565.2318	1299.2012	998.7299	663.4063	427.0848	449.7548	717.2599	1093.5309	1459.1413	1769.7638	(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	895.1238	709.5650	615.6177	379.2781	188.5064	0.0000	0.0000	0.0000	0.0000	352.4384	639.2151	909.1830	(98)
Space heating												4688.9275	(98)
Space heating per m2											(98) / (4) =	46.5264	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5020.2650	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	895.1238	709.5650	615.6177	379.2781	188.5064	0.0000	0.0000	0.0000	0.0000	352.4384	639.2151	909.1830	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	958.3766	759.7056	659.1196	406.0793	201.8270	0.0000	0.0000	0.0000	0.0000	377.3430	684.3845	973.4294	(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													
	213.1599	187.8894	197.3478	175.6799	170.0891	149.8050	143.5246	159.9963	161.7633	183.4756	193.9674	208.0419	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2648	88.0806	87.7216	86.9384	85.3104	80.3000	80.3000	80.3000	80.3000	86.6679	87.8283	88.3311	(217)
Fuel for water heating, kWh/month													
	241.5006	213.3154	224.9706	202.0740	199.3767	186.5567	178.7355	199.2482	201.4487	211.6994	220.8485	235.5250	(219)
Water heating fuel used												2515.2993	(219)
Annual totals kWh/year													
Space heating fuel - main system												5020.2650	(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)												423.5919	(232)
Total delivered energy for all uses												8034.1562	(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	5020.2650	0.2160	1084.3772	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.2993	0.2160	543.3046	(264)
Space and water heating			1627.6819	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Total CO2, kg/m2/year			1886.4511	(272)
Emissions per m2 for space and water heating			16.1508	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1814	(272b)
Emissions per m2 for pumps and fans			0.3862	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1508 * 1.00) + 2.1814 + 0.3862, rounded to 2 d.p.			18.7200	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			4.4400	
Infiltration rate			0.3755	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3755	(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	0.4788	0.4694	0.4600	0.4131	0.4037	0.3568	0.3568	0.3474	0.3755	0.4037	0.4225	0.4413	(22b)
Effective ac	0.6146	0.6102	0.6058	0.5853	0.5815	0.5636	0.5636	0.5603	0.5705	0.5815	0.5892	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639 (36)
Total fabric heat loss	(33) + (36) =	79.5270 (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	52.8401	52.4575	52.0824	50.3205	49.9909	48.4564	48.4564	48.1722	49.0474	49.9909	50.6577	51.3549	(38)
Heat transfer coeff	132.3671	131.9844	131.6093	129.8475	129.5178	127.9833	127.9833	127.6992	128.5744	129.5178	130.1847	130.8818	(39)
Average = Sum(39)m / 12 =												129.8459	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3134	1.3096	1.3059	1.2884	1.2852	1.2699	1.2699	1.2671	1.2758	1.2852	1.2918	1.2987	(40)
HLP (average)												1.2884	(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	2.7466	(42)
Average daily hot water use (litres/day)	99.4325	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801	(65)

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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	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.9855	21.3037	17.3254	13.1164	9.8047	8.2775	8.9441	11.6259	15.6043	19.8133	23.1250	24.6522	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658	(72)
Total internal gains													
	392.0952	390.6183	376.8561	354.1636	330.0605	307.7327	293.8141	297.9487	310.1286	332.9662	359.2221	379.9348	(73)

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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	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
South	5.0200	46.7521	0.4600	0.0000	0.7700	83.1291	(78)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	167.1981	281.7329	382.3943	476.9036	542.9851	544.5336	522.5922	471.3981	414.2695	310.0542	199.5835	143.5939	(83)
Total gains	559.2932	672.3513	759.2504	831.0672	873.0457	852.2663	816.4063	769.3468	724.3981	643.0203	558.8056	523.5287	(84)

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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	33.6399	33.7375	33.8336	34.2927	34.3800	34.7922	34.7922	34.8696	34.6323	34.3800	34.2039	34.0217	
alpha	3.2427	3.2492	3.2556	3.2862	3.2920	3.3195	3.3195	3.3246	3.3088	3.2920	3.2803	3.2681	
util living area													
	0.9913	0.9836	0.9694	0.9378	0.8726	0.7530	0.6117	0.6566	0.8389	0.9522	0.9853	0.9930	(86)
MIT	18.9206	19.1606	19.5254	19.9998	20.4403	20.7749	20.9191	20.8955	20.6459	20.0711	19.4108	18.8843	(87)
Th 2	19.8303	19.8333	19.8362	19.8499	19.8525	19.8645	19.8645	19.8667	19.8598	19.8525	19.8473	19.8419	(88)
util rest of house													
	0.9893	0.9798	0.9618	0.9209	0.8340	0.6715	0.4831	0.5326	0.7763	0.9359	0.9812	0.9913	(89)
MIT 2	17.9439	18.1842	18.5470	19.0206	19.4381	19.7357	19.8348	19.8248	19.6340	19.0982	18.4446	17.9161	(90)
Living area fraction										fLA = Living area / (4) =		0.1739	(91)
MIT	18.1138	18.3540	18.7172	19.1909	19.6124	19.9165	20.0234	20.0111	19.8100	19.2674	18.6127	18.0845	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1138	18.3540	18.7172	19.1909	19.6124	19.9165	20.0234	20.0111	19.8100	19.2674	18.6127	18.0845	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9850	0.9731	0.9522	0.9087	0.8243	0.6758	0.5029	0.5502	0.7730	0.9249	0.9750	0.9877	(94)
Useful gains	550.9037	654.2555	722.9301	755.1741	719.6721	575.9605	410.5441	423.3080	559.9826	594.7284	544.8245	517.1137	(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													
	1828.4965	1775.7228	1607.8957	1336.2485	1024.7975	680.4232	438.1407	461.1324	734.1618	1122.5862	1498.7726	1817.2276	(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													
	950.5290	753.6260	658.4145	418.3736	227.0133	0.0000	0.0000	0.0000	0.0000	392.7262	686.8426	967.2847	(98)
Space heating												5054.8099	(98)
Space heating per m2											(98) / (4) =	50.1569	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1203.0433	947.0766	970.5136	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7337	0.8091	0.7820	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	882.7287	766.2495	758.9184	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1102.0872	1057.9250	1004.9285	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	157.9381	217.0066	183.0315	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												557.9761	(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	39.4845	54.2516	45.7579	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												139.4940	(107)
Space cooling per m2												1.3841	(108)
Energy for space heating												50.1569	(99)
Energy for space cooling												1.3841	(108)
Total												51.5410	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.5	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1535	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4035	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4035	(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	0.5145	0.5044	0.4943	0.4439	0.4338	0.3834	0.3834	0.3733	0.4035	0.4338	0.4540	0.4742	(22b)
Effective ac	0.6324	0.6272	0.6222	0.5985	0.5941	0.5735	0.5735	0.5697	0.5814	0.5941	0.6031	0.6124	(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			2.1300	1.0000	2.1300			(26)
TER Semi-glazed door			2.1300	1.2000	2.5560			(26a)
TER Opening Type (Uw = 1.40)			16.0300	1.3258	21.2519			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507			(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.1800	23.1768			(29a)
Plane Ceiling	50.3900		50.3900	0.1300	6.5507			(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	62.2161			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.1458	(36)
Total fabric heat loss (33) + (36) =	73.3619	(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	54.3645	53.9226	53.4895	51.4551	51.0745	49.3026	49.3026	48.9745	49.9851	51.0745	51.8445	52.6495	(38)
Heat transfer coeff	127.7264	127.2845	126.8514	124.8170	124.4364	122.6645	122.6645	122.3364	123.3470	124.4364	125.2064	126.0114	(39)
Average = Sum(39)m / 12 =												124.8152	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2674	1.2630	1.2587	1.2385	1.2347	1.2172	1.2172	1.2139	1.2239	1.2347	1.2424	1.2504	(40)
HLP (average)												1.2385	(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	2.7466 (42)
Average daily hot water use (litres/day)	99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)
Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(59)

Heat gains from water heating, kWh/month

	34.4677	30.1457	31.1076	27.1204	26.0227	22.4556	20.8084	23.8779	24.1631	28.1598	30.7386	33.3801 (65)

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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	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	137.3315	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	23.9855	21.3037	17.3254	13.1164	9.8047	8.2775	8.9441	11.6259	15.6043	19.8133	23.1250	24.6522 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5826	260.2555	253.5199	239.1805	221.0797	204.0674	192.7022	190.0293	196.7649	211.1043	229.2051	246.2174 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332	36.7332 (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)

	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652 (71)

Water heating gains (Table 5)

	46.3276	44.8597	41.8114	37.6672	34.9767	31.1883	27.9683	32.0940	33.5599	37.8492	42.6925	44.8658 (72)

Total internal gains

	392.0952	390.6183	376.8561	354.1636	330.0605	307.7327	293.8141	297.9487	310.1286	332.9662	359.2221	379.9348 (73)

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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	7.6800	10.6334	0.6300	0.7000	0.7700	24.9577	(74)
South	8.3500	46.7521	0.6300	0.7000	0.7700	119.3051	(78)

Solar gains	144.2628	243.0865	329.9398	411.4848	468.5017	469.8378	450.9062	406.7346	357.4426	267.5228	172.2058	123.8966 (83)
Total gains	536.3580	633.7049	706.7959	765.6484	798.5623	777.5705	744.7203	704.6833	667.5712	600.4890	531.4279	503.8314 (84)

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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	54.7938	54.9840	55.1717	56.0710	56.2425	57.0549	57.0549	57.2079	56.7392	56.2425	55.8966	55.5395	
alpha	4.6529	4.6656	4.6781	4.7381	4.7495	4.8037	4.8037	4.8139	4.7826	4.7495	4.7264	4.7026	
util living area	0.9988	0.9971	0.9930	0.9799	0.9396	0.8316	0.6745	0.7239	0.9105	0.9859	0.9974	0.9991	(86)
MIT	19.5426	19.7058	19.9605	20.3030	20.6266	20.8726	20.9656	20.9515	20.7763	20.3556	19.8908	19.5233	(87)
Th 2	19.8665	19.8699	19.8733	19.8893	19.8923	19.9063	19.9063	19.9089	19.9009	19.8923	19.8863	19.8799	(88)
util rest of house	0.9984	0.9961	0.9902	0.9711	0.9099	0.7469	0.5308	0.5860	0.8545	0.9781	0.9964	0.9988	(89)
MIT 2	18.5410	18.7064	18.9627	19.3132	19.6236	19.8418	19.8968	19.8938	19.7675	19.3702	18.9043	18.5322	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.7152	18.8803	19.1363	19.4854	19.7981	20.0211	20.0827	20.0778	19.9430	19.5416	19.0759	18.7046	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7152	18.8803	19.1363	19.4854	19.7981	20.0211	20.0827	20.0778	19.9430	19.5416	19.0759	18.7046	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9948	0.9878	0.9669	0.9068	0.7573	0.5560	0.6097	0.8571	0.9747	0.9952	0.9983	(94)
Useful gains	535.1334	630.3945	698.1403	740.2673	724.1127	588.8415	414.0675	429.6763	572.2056	585.2807	528.8733	502.9787	(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	1841.2031	1779.4711	1602.9269	1321.2376	1007.6960	664.9721	427.2089	449.9309	720.7114	1112.6573	1499.4600	1827.7471	(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	971.7158	772.1794	673.1612	418.2986	210.9860	0.0000	0.0000	0.0000	0.0000	392.3682	698.8225	985.6276	(98)
Space heating												5123.1594	(98)
Space heating per m2											(98) / (4) =	50.8351	(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	1153.0466	907.7176	929.7567	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7709	0.8556	0.8278	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	888.9387	776.6056	769.6666	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1014.7804	974.1361	929.3478	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	90.6060	146.9627	118.8028	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												356.3715	(104)

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	22.6515	36.7407	29.7007	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												89.0929 (107)
Space cooling per m2												0.8840 (108)
Energy for space heating												50.8351 (99)
Energy for space cooling												0.8840 (108)
Total												51.7191 (109)
Target Fabric Energy Efficiency (TFEE)												59.5 (109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1919	(8)
Pressure test		Yes	
Measured/design AP50		4.4400	
Infiltration rate		0.4139	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4139	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4346	0.4036	0.4139	0.3932	0.3932	0.3829	0.3725	0.3622	0.3518	0.3829	0.3622	0.3829	(22b)
Effective ac	0.5944	0.5814	0.5857	0.5773	0.5773	0.5733	0.5694	0.5656	0.5619	0.5733	0.5656	0.5733	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639 (36)
Total fabric heat loss	(33) + (36) =	79.5270 (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	51.1050	49.9864	50.3501	49.6320	49.6320	49.2868	48.9507	48.6239	48.3063	49.2868	48.6239	49.2868	(38)
Heat transfer coeff	130.6319	129.5134	129.8770	129.1589	129.1589	128.8137	128.4777	128.1509	127.8333	128.8137	128.1509	128.8137	(39)
Average = Sum(39)m / 12 =												128.9495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2962	1.2851	1.2887	1.2816	1.2816	1.2782	1.2748	1.2716	1.2684	1.2782	1.2716	1.2782	(40)
HLP (average)												1.2795	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
RHI water heating demand												1730	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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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	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9638	53.2593	43.3134	32.7910	24.5117	20.6938	22.3604	29.0649	39.0108	49.5332	57.8125	61.6304	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	633.8168	628.8007	604.0233	565.6002	526.0834	490.9329	470.5899	479.7746	502.0750	540.7254	583.6130	616.2290	(73)

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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	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
South	5.0200	56.7559	0.4600	0.0000	0.7700	100.9167	(78)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	204.5391	293.5079	403.4547	511.2427	558.0552	610.1137	580.0595	532.4582	463.2488	348.8985	243.3604	172.7041	(83)
Total gains	838.3559	922.3087	1007.4780	1076.8429	1084.1386	1101.0466	1050.6495	1012.2328	965.3238	889.6239	826.9734	788.9330	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0868	34.3812	34.2849	34.4755	34.4755	34.5679	34.6583	34.7467	34.8330	34.5679	34.7467	34.5679	
alpha	3.2725	3.2921	3.2857	3.2984	3.2984	3.3045	3.3106	3.3164	3.3222	3.3045	3.3164	3.3045	
util living area													
	0.9698	0.9581	0.9304	0.8729	0.7722	0.5963	0.4545	0.4685	0.6948	0.8753	0.9491	0.9737	(86)
MIT	19.3732	19.5464	19.8872	20.3099	20.6701	20.9016	20.9701	20.9676	20.8291	20.4200	19.8660	19.3626	(87)
Th 2	19.8438	19.8525	19.8497	19.8553	19.8553	19.8580	19.8606	19.8632	19.8656	19.8580	19.8632	19.8580	(88)
util rest of house													
	0.9631	0.9491	0.9147	0.8427	0.7144	0.4999	0.3314	0.3428	0.6081	0.8387	0.9361	0.9679	(89)
MIT 2	17.7298	17.9832	18.4670	19.0583	19.5300	19.7898	19.8485	19.8499	19.7294	19.2210	18.4529	17.7241	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0156	18.2551	18.7140	19.2760	19.7283	19.9832	20.0436	20.0443	19.9206	19.4295	18.6987	18.0091	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8656	18.1051	18.5640	19.1260	19.5783	19.8332	19.8936	19.8943	19.7706	19.2795	18.5487	17.8591	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9300	0.8918	0.8192	0.6983	0.4976	0.3351	0.3464	0.5999	0.8155	0.9154	0.9529	(94)
Useful gains	793.7534	857.7840	898.4663	882.1270	757.0027	547.8572	352.1015	350.6325	579.1415	725.4965	757.0423	751.7927	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1693.7272	1658.4364	1501.8990	1243.2812	914.2229	583.9338	358.9167	358.0907	648.1970	1014.9917	1364.6462	1656.4272	(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													
	669.5805	538.0384	448.9540	260.0310	116.9719	0.0000	0.0000	0.0000	0.0000	215.3845	437.4747	673.0481	(98)
Space heating												3359.4829	(98)
RHI space heating demand												3359	(98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =			50.0000 / (5) =	0.1919	(8)
Pressure test				Yes	
Measured/design AP50				4.4400	
Infiltration rate				0.4139	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.4139	(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	0.5278	0.5174	0.5071	0.4553	0.4450	0.3932	0.3932	0.3829	0.4139	0.4450	0.4657	0.4864	(22b)
Effective ac	0.6393	0.6339	0.6286	0.6037	0.5990	0.5773	0.5773	0.5733	0.5857	0.5990	0.6084	0.6183	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639 (36)
Total fabric heat loss	(33) + (36) =	79.5270 (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	54.9577	54.4928	54.0371	51.8967	51.4962	49.6320	49.6320	49.2868	50.3501	51.4962	52.3064	53.1533	(38)
Heat transfer coeff	134.4847	134.0198	133.5641	131.4236	131.0232	129.1589	129.1589	128.8137	129.8770	131.0232	131.8333	132.6803	(39)
Average = Sum(39)m / 12 =												131.4217	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3344	1.3298	1.3253	1.3041	1.3001	1.2816	1.2816	1.2782	1.2887	1.3001	1.3081	1.3165	(40)
HLP (average)												1.3040	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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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	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9638	53.2593	43.3134	32.7910	24.5117	20.6938	22.3604	29.0649	39.0108	49.5332	57.8125	61.6304	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	633.8168	628.8007	604.0233	565.6002	526.0834	490.9329	470.5899	479.7746	502.0750	540.7254	583.6130	616.2290	(73)

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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	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
South	5.0200	46.7521	0.4600	0.0000	0.7700	83.1291	(78)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	167.1981	281.7329	382.3943	476.9036	542.9851	544.5336	522.5922	471.3981	414.2695	310.0542	199.5835	143.5939	(83)
Total gains	801.0149	910.5337	986.4177	1042.5037	1069.0686	1035.4665	993.1821	951.1727	916.3445	850.7795	783.1965	759.8229	(84)

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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	33.1103	33.2251	33.3385	33.8814	33.9850	34.4755	34.4755	34.5679	34.2849	33.9850	33.7761	33.5605	
alpha	3.2074	3.2150	3.2226	3.2588	3.2657	3.2984	3.2984	3.3045	3.2857	3.2657	3.2517	3.2374	
util living area													
	0.9761	0.9629	0.9408	0.8957	0.8130	0.6748	0.5295	0.5664	0.7581	0.9068	0.9629	0.9796	(86)
MIT	19.1713	19.3981	19.7372	20.1739	20.5599	20.8382	20.9463	20.9319	20.7454	20.2554	19.6443	19.1372	(87)
Th 2	19.8140	19.8175	19.8211	19.8377	19.8408	19.8553	19.8553	19.8580	19.8497	19.8408	19.8345	19.8279	(88)
util rest of house													
	0.9709	0.9549	0.9274	0.8706	0.7647	0.5885	0.4086	0.4472	0.6831	0.8793	0.9535	0.9751	(89)
MIT 2	17.4197	17.7483	18.2360	18.8610	19.3811	19.7267	19.8282	19.8207	19.6262	18.9871	18.1182	17.3791	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7243	18.0353	18.4972	19.0894	19.5862	19.9201	20.0227	20.0140	19.8209	19.2077	18.3836	17.6849	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5743	17.8853	18.3472	18.9394	19.4362	19.7701	19.8727	19.8640	19.6709	19.0577	18.2336	17.5349	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9563	0.9364	0.9050	0.8462	0.7448	0.5814	0.4106	0.4479	0.6695	0.8551	0.9350	0.9620	(94)
Useful gains	766.0286	852.6648	892.6604	882.1626	796.2297	601.9845	407.8154	426.0146	613.5026	727.4948	732.2943	730.9245	(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													
	1785.1950	1740.2817	1582.3548	1319.4142	1013.6175	667.7602	422.7004	446.2131	723.5276	1108.1555	1467.7858	1769.2811	(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													
	758.2598	596.4785	513.1326	314.8212	161.7365	0.0000	0.0000	0.0000	0.0000	283.2115	529.5539	772.5373	(98)
Space heating												3929.7313	(98)
Space heating per m2											(98) / (4) =	38.9932	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4342.2446	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	758.2598	596.4785	513.1326	314.8212	161.7365	0.0000	0.0000	0.0000	0.0000	283.2115	529.5539	772.5373	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	837.8561	659.0923	566.9973	347.8687	178.7144	0.0000	0.0000	0.0000	0.0000	312.9409	585.1424	853.6324	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8784	89.8222	89.7165	89.4842	89.0068	87.3000	87.3000	87.3000	87.3000	89.3826	89.7429	89.9021	(217)
Fuel for water heating, kWh/month													
	196.2061	172.1488	178.8934	157.8342	153.3488	136.5557	128.1658	144.7599	145.8047	164.0043	176.4064	190.4477	(219)
Water heating fuel used												1944.5759	(219)
Annual totals kWh/year													
Space heating fuel - main system												4342.2446	(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)												423.5919	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												5596.6808	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4342.2446	3.4800	151.1101	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1944.5759	3.4800	67.6712	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	423.5919	13.1900	55.8718	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			247.7519	(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] =	0.7138	(257)
SAP value		90.0427	
SAP rating (Section 12)		90	(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	4342.2446	0.2160	937.9248	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1944.5759	0.2160	420.0284	(264)
Space and water heating			1357.9532	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			999.7708	(272)
CO2 emissions per m2			9.9200	(273)
EI value			90.8102	
EI rating			91	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.4400	
Infiltration rate			0.4139	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4139	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4346	0.4036	0.4139	0.3932	0.3932	0.3829	0.3725	0.3622	0.3518	0.3829	0.3622	0.3829	(22b)
Effective ac	0.5944	0.5814	0.5857	0.5773	0.5773	0.5733	0.5694	0.5656	0.5619	0.5733	0.5656	0.5733	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639	(36)
Total fabric heat loss	(33) + (36) =	79.5270	(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	51.1050	49.9864	50.3501	49.6320	49.6320	49.2868	48.9507	48.6239	48.3063	49.2868	48.6239	49.2868	(38)
Heat transfer coeff	130.6319	129.5134	129.8770	129.1589	129.1589	128.8137	128.4777	128.1509	127.8333	128.8137	128.1509	128.8137	(39)
Average = Sum(39)m / 12 =												128.9495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2962	1.2851	1.2887	1.2816	1.2816	1.2782	1.2748	1.2716	1.2684	1.2782	1.2716	1.2782	(40)
HLP (average)												1.2795	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

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

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
									Total per year (kWh/year) = Sum(64)m =			1730.0840	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(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	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9638	53.2593	43.3134	32.7910	24.5117	20.6938	22.3604	29.0649	39.0108	49.5332	57.8125	61.6304	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	633.8168	628.8007	604.0233	565.6002	526.0834	490.9329	470.5899	479.7746	502.0750	540.7254	583.6130	616.2290	(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	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
South	5.0200	56.7559	0.4600	0.0000	0.7700	100.9167	(78)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	204.5391	293.5079	403.4547	511.2427	558.0552	610.1137	580.0595	532.4582	463.2488	348.8985	243.3604	172.7041	(83)
Total gains	838.3559	922.3087	1007.4780	1076.8429	1084.1386	1101.0466	1050.6495	1012.2328	965.3238	889.6239	826.9734	788.9330	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0868	34.3812	34.2849	34.4755	34.4755	34.5679	34.6583	34.7467	34.8330	34.5679	34.7467	34.5679	
alpha	3.2725	3.2921	3.2857	3.2984	3.2984	3.3045	3.3106	3.3164	3.3222	3.3045	3.3164	3.3045	
util living area													
	0.9698	0.9581	0.9304	0.8729	0.7722	0.5963	0.4545	0.4685	0.6948	0.8753	0.9491	0.9737	(86)
MIT	19.3732	19.5464	19.8872	20.3099	20.6701	20.9016	20.9701	20.9676	20.8291	20.4200	19.8660	19.3626	(87)
Th 2	19.8438	19.8525	19.8497	19.8553	19.8553	19.8580	19.8606	19.8632	19.8656	19.8580	19.8632	19.8580	(88)
util rest of house													
	0.9631	0.9491	0.9147	0.8427	0.7144	0.4999	0.3314	0.3428	0.6081	0.8387	0.9361	0.9679	(89)
MIT 2	17.7298	17.9832	18.4670	19.0583	19.5300	19.7898	19.8485	19.8499	19.7294	19.2210	18.4529	17.7241	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0156	18.2551	18.7140	19.2760	19.7283	19.9832	20.0436	20.0443	19.9206	19.4295	18.6987	18.0091	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8656	18.1051	18.5640	19.1260	19.5783	19.8332	19.8936	19.8943	19.7706	19.2795	18.5487	17.8591	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9300	0.8918	0.8192	0.6983	0.4976	0.3351	0.3464	0.5999	0.8155	0.9154	0.9529	(94)
Useful gains	793.7534	857.7840	898.4663	882.1270	757.0027	547.8572	352.1015	350.6325	579.1415	725.4965	757.0423	751.7927	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1693.7272	1658.4364	1501.8990	1243.2812	914.2229	583.9338	358.9167	358.0907	648.1970	1014.9917	1364.6462	1656.4272	(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													
	669.5805	538.0384	448.9540	260.0310	116.9719	0.0000	0.0000	0.0000	0.0000	215.3845	437.4747	673.0481	(98)
Space heating												3359.4829	(98)
Space heating per m2											(98) / (4) =	33.3348	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3712.1358	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	669.5805	538.0384	448.9540	260.0310	116.9719	0.0000	0.0000	0.0000	0.0000	215.3845	437.4747	673.0481	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	739.8679	594.5176	496.0817	287.3270	129.2507	0.0000	0.0000	0.0000	0.0000	237.9939	483.3975	743.6995	(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													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8137	89.7655	89.6348	89.3473	88.7482	87.3000	87.3000	87.3000	87.3000	89.1762	89.6270	89.8322	(217)
Fuel for water heating, kWh/month													
	196.3474	172.2575	179.0565	158.0761	153.7957	136.5557	128.1658	144.7599	145.8047	164.3838	176.6345	190.5960	(219)
Water heating fuel used												1946.4336	(219)
Annual totals kWh/year													
Space heating fuel - main system												3712.1358	(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)												423.5919	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												4828.8073	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3712.1358	10.2300	379.7515	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1946.4336	10.2300	199.1202	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	423.5919	36.7200	155.5429	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			377.1830	(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	3712.1358	0.2160	801.8213	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.4336	0.2160	420.4297	(264)
Space and water heating			1222.2510	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Energy saving/generation technologies				
PV Unit	-1328.3540	0.5190	-689.4157	(269)
Total kg/year			791.6044	(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	3712.1358	1.2200	4528.8057	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1946.4336	1.2200	2374.6490	(264)
Space and water heating			6903.4547	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	423.5919	3.0700	1300.4271	(268)
Energy saving/generation technologies				
PV Unit	-1328.3540	3.0700	-4078.0469	(269)
Primary energy kWh/year			4356.0849	(272)
Primary energy kWh/m2/year			43.2237	(273)

SAP 2012 EPC IMPROVEMENTS

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

(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	+ 1.1	-£ 85	-193 kg (24.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£85	1.92 kg/m²	B 91	A 93
Total Savings	£85	1.92 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
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	£183	£201	-£18
Mains gas	£682	£578	£104
Space heating	£510	£510	£0
Water heating	£199	£114	£85
Lighting	£156	£156	£0
Generated (PV)	-£488	-£488	£0
Total cost of fuels	£377	£291	£86
Total cost of uses	£377	£292	£85
Delivered energy	48 kWh/m²	38 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	32 kWh/m²	11 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.4400	
Infiltration rate			0.4139	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4139	(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	0.5278	0.5174	0.5071	0.4553	0.4450	0.3932	0.3932	0.3829	0.4139	0.4450	0.4657	0.4864	(22b)
Effective ac	0.6393	0.6339	0.6286	0.6037	0.5990	0.5773	0.5773	0.5733	0.5857	0.5990	0.6084	0.6183	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639 (36)
Total fabric heat loss	(33) + (36) =	79.5270 (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	54.9577	54.4928	54.0371	51.8967	51.4962	49.6320	49.6320	49.2868	50.3501	51.4962	52.3064	53.1533	(38)
Heat transfer coeff	134.4847	134.0198	133.5641	131.4236	131.0232	129.1589	129.1589	128.8137	129.8770	131.0232	131.8333	132.6803	(39)
Average = Sum(39)m / 12 =												131.4217	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3344	1.3298	1.3253	1.3041	1.3001	1.2816	1.2816	1.2782	1.2887	1.3001	1.3081	1.3165	(40)
HLP (average)												1.3040	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(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												1.1593	(H8)
Utilisation factor												0.5779	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-869.6671	(H17)
Solar input	-25.2186	-42.0826	-71.6715	-96.0539	-118.6666	-116.6681	-115.1263	-100.5864	-78.7794	-53.7970	-29.9129	-21.1037	(63)
								Solar input (sum of months) = Sum(63)m =				-869.6671	(63)
Output from w/h													
	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
									Total per year (kWh/year) = Sum(64)m =			863.6545	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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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	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9638	53.2593	43.3134	32.7910	24.5117	20.6938	22.3604	29.0649	39.0108	49.5332	57.8125	61.6304	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	633.8168	628.8007	604.0233	565.6002	526.0834	490.9329	470.5899	479.7746	502.0750	540.7254	583.6130	616.2290	(73)

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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	7.6800	10.6334	0.4600	0.0000	0.7700	28.9255	(74)
South	5.0200	46.7521	0.4600	0.0000	0.7700	83.1291	(78)
South	3.3300	46.7521	0.4600	0.0000	0.7700	55.1434	(78)

Solar gains	167.1981	281.7329	382.3943	476.9036	542.9851	544.5336	522.5922	471.3981	414.2695	310.0542	199.5835	143.5939	(83)
Total gains	801.0149	910.5337	986.4177	1042.5037	1069.0686	1035.4665	993.1821	951.1727	916.3445	850.7795	783.1965	759.8229	(84)

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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	33.1103	33.2251	33.3385	33.8814	33.9850	34.4755	34.4755	34.5679	34.2849	33.9850	33.7761	33.5605	
alpha	3.2074	3.2150	3.2226	3.2588	3.2657	3.2984	3.2984	3.3045	3.2857	3.2657	3.2517	3.2374	
util living area													
	0.9761	0.9629	0.9408	0.8957	0.8130	0.6748	0.5295	0.5664	0.7581	0.9068	0.9629	0.9796	(86)
MIT	19.1713	19.3981	19.7372	20.1739	20.5599	20.8382	20.9463	20.9319	20.7454	20.2554	19.6443	19.1372	(87)
Th 2	19.8140	19.8175	19.8211	19.8377	19.8408	19.8553	19.8553	19.8580	19.8497	19.8408	19.8345	19.8279	(88)
util rest of house													
	0.9709	0.9549	0.9274	0.8706	0.7647	0.5885	0.4086	0.4472	0.6831	0.8793	0.9535	0.9751	(89)
MIT 2	17.4197	17.7483	18.2360	18.8610	19.3811	19.7267	19.8282	19.8207	19.6262	18.9871	18.1182	17.3791	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	17.7243	18.0353	18.4972	19.0894	19.5862	19.9201	20.0227	20.0140	19.8209	19.2077	18.3836	17.6849	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5743	17.8853	18.3472	18.9394	19.4362	19.7701	19.8727	19.8640	19.6709	19.0577	18.2336	17.5349	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9563	0.9364	0.9050	0.8462	0.7448	0.5814	0.4106	0.4479	0.6695	0.8551	0.9350	0.9620	(94)
Useful gains	766.0286	852.6648	892.6604	882.1626	796.2297	601.9845	407.8154	426.0146	613.5026	727.4948	732.2943	730.9245	(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	1785.1950	1740.2817	1582.3548	1319.4142	1013.6175	667.7602	422.7004	446.2131	723.5276	1108.1555	1467.7858	1769.2811	(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	758.2598	596.4785	513.1326	314.8212	161.7365	0.0000	0.0000	0.0000	0.0000	283.2115	529.5539	772.5373	(98)
Space heating												3929.7313	(98)
Space heating per m2											(98) / (4) =	38.9932	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4342.2446	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	758.2598	596.4785	513.1326	314.8212	161.7365	0.0000	0.0000	0.0000	0.0000	283.2115	529.5539	772.5373	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	837.8561	659.0923	566.9973	347.8687	178.7144	0.0000	0.0000	0.0000	0.0000	312.9409	585.1424	853.6324	(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	151.1282	112.5452	88.8253	45.1827	17.8243	2.5450	0.0000	25.7890	48.5082	92.7942	128.3994	150.1129	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9520	89.9765	90.0131	90.0856	90.1719	87.3000	87.3000	87.3000	87.3000	89.6887	89.8572	89.9635	(217)
Fuel for water heating, kWh/month	168.0098	125.0829	98.6804	50.1554	19.7671	2.9152	0.0000	29.5406	55.5649	103.4626	142.8926	166.8598	(219)
Water heating fuel used												962.9313	(219)
Annual totals kWh/year													
Space heating fuel - main system												4342.2446	(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)												423.5919	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1004 * 1.00) =										-1188.7315		-1188.7315	(233)
Total delivered energy for all uses												4665.0363	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4342.2446	3.4800	151.1101	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	962.9313	3.4800	33.5100	(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	423.5919	13.1900	55.8718	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1188.7315	13.1900	-156.7937	(252)
Total energy cost			220.1857	(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] =	0.6344	(257)
SAP value	91.1506	
SAP rating (Section 12)	91	(258)
SAP band	B	

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4342.2446	0.2160	937.9248	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	962.9313	0.2160	207.9932	(264)
Space and water heating			1145.9180	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Energy saving/generation technologies				
PV Unit	-1188.7315	0.5190	-616.9517	(269)
Total kg/year			813.6855	(272)
CO2 emissions per m2			8.0700	(273)
EI value			92.5207	
EI rating			93	(274)
EI band			A	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.3900 (1b)	x	2.5400 (2b)	=	127.9906	(1b) - (3b)
First floor	50.3900 (1c)	x	2.6300 (2c)	=	132.5257	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	100.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	260.5163	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.1919	(8)
Pressure test			Yes	
Measured/design AP50			4.4400	
Infiltration rate			0.4139	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4139	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.4346	0.4036	0.4139	0.3932	0.3932	0.3829	0.3725	0.3622	0.3518	0.3829	0.3622	0.3829	(22b)
Effective ac	0.5944	0.5814	0.5857	0.5773	0.5773	0.5733	0.5694	0.5656	0.5619	0.5733	0.5656	0.5733	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Half Glaze			2.1300	1.4000	2.9820			(26a)
Window (Uw = 1.30)			12.7000	1.2357	15.6939			(27)
French Door (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
GF B&B J150 P/A=0.60			50.3900	0.1300	6.5507	75.0000	3779.2500	(28a)
EW Brick AAC015	149.0500	20.2900	128.7600	0.2500	32.1900	52.3000	6734.1480	(29a)
Plane Ceiling	50.3900		50.3900	0.1600	8.0624	9.0000	453.5100	(30)
Total net area of external elements Aum(A, m2)			249.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.3630			(33)
GF Timber			59.4900			9.0000	535.4100	(32c)
1F Timber			99.5900			9.0000	896.3100	(32c)
GF Masonry			30.2800			75.0000	2271.0000	(32c)
Internal Floor			50.3900			18.0000	907.0200	(32d)
Internal Ceiling			50.3900			9.0000	453.5100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	16030.1580	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.0609	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.1639	(36)
Total fabric heat loss	(33) + (36) =	79.5270	(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	51.1050	49.9864	50.3501	49.6320	49.6320	49.2868	48.9507	48.6239	48.3063	49.2868	48.6239	49.2868	(38)
Heat transfer coeff	130.6319	129.5134	129.8770	129.1589	129.1589	128.8137	128.4777	128.1509	127.8333	128.8137	128.1509	128.8137	(39)
Average = Sum(39)m / 12 =												128.9495	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2962	1.2851	1.2887	1.2816	1.2816	1.2782	1.2748	1.2716	1.2684	1.2782	1.2716	1.2782	(40)
HLP (average)												1.2795	(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		2.7466 (42)
Average daily hot water use (litres/day)		99.4325 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3757	105.3984	101.4211	97.4438	93.4665	89.4892	89.4892	93.4665	97.4438	101.4211	105.3984	109.3757	(44)

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

Energy conte	162.2010	141.8620	146.3889	127.6254	122.4596	105.6733	97.9219	112.3668	113.7088	132.5167	144.6523	157.0830	(45)
Energy content (annual)										Total = Sum(45)m =		1564.4598	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.3302	21.2793	21.9583	19.1438	18.3689	15.8510	14.6883	16.8550	17.0563	19.8775	21.6978	23.5625	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1458	12.7657	14.1079	13.6113	14.0313	13.5398	13.9669	14.0086	13.5787	14.0746	13.6600	14.1336	(61)
Total heat required for water heating calculated for each month													
	176.3469	154.6278	160.4968	141.2367	136.4909	119.2131	111.8888	126.3754	127.2875	146.5913	158.3123	171.2166	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1208.1510	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2029.6937	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2974	(H8)
Utilisation factor												0.5374	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												99.4325	(H14)
Volume ratio Veff/V												0.7543	(H15)
Solar storage volume factor												0.9436	(H16)
Solar input												-904.9218	(H17)
Solar input	-29.5207	-41.9766	-72.1477	-97.3440	-114.3363	-122.1293	-119.5609	-107.0106	-83.7819	-57.9239	-34.9153	-24.2746	(63)
								Solar input (sum of months) = Sum(63)m =				-904.9218	(63)
Output from w/h													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
								Total per year (kWh/year) = Sum(64)m =				835.7504	(64)
Heat gains from water heating, kWh/month													
	57.4683	50.3606	52.2013	45.8383	44.2256	38.5213	36.0507	40.8641	41.2029	47.5804	51.5119	55.7635	(65)

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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	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	164.7978	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	59.9638	53.2593	43.3134	32.7910	24.5117	20.6938	22.3604	29.0649	39.0108	49.5332	57.8125	61.6304	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.4517	388.4411	378.3879	356.9859	329.9697	304.5783	287.6152	283.6258	293.6790	315.0810	342.0972	367.4886	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	54.2264	(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)													
	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	-109.8652	(71)
Water heating gains (Table 5)													
	77.2423	74.9413	70.1630	63.6643	59.4431	53.5018	48.4553	54.9249	57.2262	63.9522	71.5443	74.9509	(72)
Total internal gains													
	633.8168	628.8007	604.0233	565.6002	526.0834	490.9329	470.5899	479.7746	502.0750	540.7254	583.6130	616.2290	(73)

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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	7.6800	13.4839	0.4600	0.0000	0.7700	36.6796	(74)
South	5.0200	56.7559	0.4600	0.0000	0.7700	100.9167	(78)
South	3.3300	56.7559	0.4600	0.0000	0.7700	66.9427	(78)

Solar gains	204.5391	293.5079	403.4547	511.2427	558.0552	610.1137	580.0595	532.4582	463.2488	348.8985	243.3604	172.7041	(83)
Total gains	838.3559	922.3087	1007.4780	1076.8429	1084.1386	1101.0466	1050.6495	1012.2328	965.3238	889.6239	826.9734	788.9330	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.0868	34.3812	34.2849	34.4755	34.4755	34.5679	34.6583	34.7467	34.8330	34.5679	34.7467	34.5679	
alpha	3.2725	3.2921	3.2857	3.2984	3.2984	3.3045	3.3106	3.3164	3.3222	3.3045	3.3164	3.3045	
util living area													
	0.9698	0.9581	0.9304	0.8729	0.7722	0.5963	0.4545	0.4685	0.6948	0.8753	0.9491	0.9737	(86)
MIT	19.3732	19.5464	19.8872	20.3099	20.6701	20.9016	20.9701	20.9676	20.8291	20.4200	19.8660	19.3626	(87)
Th 2	19.8438	19.8525	19.8497	19.8553	19.8553	19.8580	19.8606	19.8632	19.8656	19.8580	19.8632	19.8580	(88)
util rest of house													
	0.9631	0.9491	0.9147	0.8427	0.7144	0.4999	0.3314	0.3428	0.6081	0.8387	0.9361	0.9679	(89)
MIT 2	17.7298	17.9832	18.4670	19.0583	19.5300	19.7898	19.8485	19.8499	19.7294	19.2210	18.4529	17.7241	(90)
Living area fraction									fLA = Living area / (4) =			0.1739	(91)
MIT	18.0156	18.2551	18.7140	19.2760	19.7283	19.9832	20.0436	20.0443	19.9206	19.4295	18.6987	18.0091	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8656	18.1051	18.5640	19.1260	19.5783	19.8332	19.8936	19.8943	19.7706	19.2795	18.5487	17.8591	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9468	0.9300	0.8918	0.8192	0.6983	0.4976	0.3351	0.3464	0.5999	0.8155	0.9154	0.9529	(94)
Useful gains	793.7534	857.7840	898.4663	882.1270	757.0027	547.8572	352.1015	350.6325	579.1415	725.4965	757.0423	751.7927	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1693.7272	1658.4364	1501.8990	1243.2812	914.2229	583.9338	358.9167	358.0907	648.1970	1014.9917	1364.6462	1656.4272	(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													
	669.5805	538.0384	448.9540	260.0310	116.9719	0.0000	0.0000	0.0000	0.0000	215.3845	437.4747	673.0481	(98)
Space heating												3359.4829	(98)
Space heating per m2											(98) / (4) =	33.3348	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3712.1358	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	669.5805	538.0384	448.9540	260.0310	116.9719	0.0000	0.0000	0.0000	0.0000	215.3845	437.4747	673.0481	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	739.8679	594.5176	496.0817	287.3270	129.2507	0.0000	0.0000	0.0000	0.0000	237.9939	483.3975	743.6995	(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													
	146.8261	112.6512	88.3491	43.8927	22.1545	0.0000	0.0000	19.3648	43.5056	88.6673	123.3970	146.9419	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9073	89.9293	89.9578	90.0234	89.9748	87.3000	87.3000	87.3000	87.3000	89.5428	89.7760	89.9094	(217)
Fuel for water heating, kWh/month													
	163.3083	125.2664	98.2117	48.7570	24.6231	0.0000	0.0000	22.1819	49.8346	99.0222	137.4499	163.4333	(219)
Water heating fuel used												932.0885	(219)
Annual totals kWh/year													
Space heating fuel - main system												3712.1358	(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)												423.5919	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 1122 * 1.00) =										-1328.3540		-1328.3540	(233)
Total delivered energy for all uses												3864.4621	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3712.1358	10.2300	379.7515	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	932.0885	10.2300	95.3527	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	423.5919	36.7200	155.5429	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1328.3540	36.7200	-487.7716	(252)
Total energy cost			291.7755	(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	3712.1358	0.2160	801.8213	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0885	0.2160	201.3311	(264)
Space and water heating			1003.1524	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	423.5919	0.5190	219.8442	(268)
Energy saving/generation technologies				

PV Unit	-1328.3540	0.5190	-689.4157 (269)
Total kg/year			598.4559 (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	3712.1358	1.2200	4528.8057	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.0885	1.2200	1137.1479	(264)
Space and water heating			5665.9536	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	423.5919	3.0700	1300.4271	(268)
Energy saving/generation technologies				
PV Unit	-1328.3540	3.0700	-4078.0469	(269)
Primary energy kWh/year			3272.0838	(272)
Primary energy kWh/m2/year			32.4676	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	159.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		343.88 (P1)
Transmission heat loss coefficient		79.53 (37)
Summer heat loss coefficient		423.41 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
South	0.000	1.000	None

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.6800	87.1704	0.4600	0.0000	0.9000	277.1602
South	5.0200	118.5567	0.4600	0.0000	0.9000	246.3940
South	3.3300	118.5567	0.4600	0.0000	0.9000	163.4446
total:						686.9987

	Jun	Jul	Aug	
Solar gains	735	687	628	(P4)
Internal gains	488	468	477	
Total summer gains	1222	1155	1105	(P5)
Summer gain/loss ratio	2.89	2.73	2.61	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 159.1)	0.89	0.89	0.89	
Threshold temperature	19.17	20.91	20.80	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

AES Sustainability Consultants

Property Reference	4907-P637-6633-630	**Issued on Date**	15/12/2023
Assessment Reference	As Built	**Prop Type Ref**	Darwen-As-DET
Property	32, Chaffinch Gardens , Botley, Southampton, SO32 2US		

SAP Rating	88 B	**DER**	13.25	**TER**	17.06
Environmental	88 B	**% DER<TER**	22.33		
CO_2 Emissions (t/year)	1.25	**DFEE**	50.28	**TFEE**	58.59
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.18		

Assessor Details	Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk	**Assessor ID**	Q919-0001
Client			

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 122 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.06 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.25 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 4.39 (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
Ideal LOGIC HEAT H15

Efficiency: 89.4% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.35 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control 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: 1.03 m², No overhang
Windows facing North East: 7.08 m², No overhang
Windows facing South East: 6.50 m², No overhang
Windows facing South West: 8.16 m², No overhang
Windows facing West: 1.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Thermal bridging y-value 0.030 W/m²K
Photovoltaic array 1.48 kW

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.3900	
Infiltration rate		0.3467	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3901	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	62.0162	61.6225	61.2367	59.4242	59.0850	57.5064	57.5064	57.2141	58.1145	59.0850	59.7711	60.4883	(38)
Heat transfer coeff	158.8912	158.4976	158.1117	156.2992	155.9601	154.3814	154.3814	154.0891	154.9895	155.9601	156.6461	157.3633	(39)
Average = Sum(39)m / 12 =												156.2976	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3061	1.3029	1.2997	1.2848	1.2820	1.2691	1.2691	1.2667	1.2741	1.2820	1.2877	1.2936	(40)
HLP (average)												1.2848	(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	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	506.1781	503.9041	487.1911	459.9822	431.8858	405.1596	388.0137	394.5683	408.7327	436.1753	467.7391	491.8640	(73)

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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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	230.3939	404.4617	584.7250	776.0358	915.5608	929.1343	887.3945	780.3391	650.5759	455.5191	278.1613	195.7362	(83)
Total gains	736.5719	908.3658	1071.9161	1236.0180	1347.4466	1334.2940	1275.4081	1174.9074	1059.3085	891.6944	745.9004	687.6001	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9050	31.9843	32.0624	32.4342	32.5047	32.8371	32.8371	32.8994	32.7082	32.5047	32.3623	32.2148	
alpha	3.1270	3.1323	3.1375	3.1623	3.1670	3.1891	3.1891	3.1933	3.1805	3.1670	3.1575	3.1477	
util living area													
	0.9868	0.9743	0.9488	0.8912	0.7872	0.6375	0.4966	0.5491	0.7644	0.9262	0.9774	0.9893	(86)
MIT	18.9118	19.1919	19.6151	20.1394	20.5750	20.8497	20.9498	20.9303	20.7162	20.1318	19.4228	18.8650	(87)
Th 2	19.8360	19.8386	19.8410	19.8527	19.8549	19.8651	19.8651	19.8670	19.8612	19.8549	19.8505	19.8459	(88)
util rest of house													
	0.9839	0.9687	0.9374	0.8663	0.7376	0.5532	0.3826	0.4339	0.6923	0.9039	0.9716	0.9869	(89)
MIT 2	17.0678	17.4748	18.0847	18.8293	19.4110	19.7453	19.8393	19.8279	19.6058	18.8369	17.8207	17.0055	(90)
Living area fraction										fLA = Living area / (4) =		0.1417	(91)
MIT	17.3291	17.7182	18.3016	19.0150	19.5760	19.9018	19.9967	19.9841	19.7632	19.0204	18.0477	17.2691	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1791	17.5682	18.1516	18.8650	19.4260	19.7518	19.8467	19.8341	19.6132	18.8704	17.8977	17.1191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9734	0.9526	0.9144	0.8392	0.7160	0.5439	0.3806	0.4303	0.6738	0.8779	0.9564	0.9779	(94)
Useful gains	716.9738	865.2713	980.2003	1037.2857	964.7380	725.6729	485.4368	505.5547	713.7512	782.8054	713.3863	672.4294	(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													
	2046.3761	2007.8769	1842.2522	1557.5230	1204.9428	795.3465	501.2290	529.1613	854.4862	1289.8482	1691.4222	2032.9860	(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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating kWh

989.0753	767.8310	641.3666	374.5709	178.7124	0.0000	0.0000	0.0000	0.0000	377.2398	704.1858	1012.2541	(98)
Space heating											5045.2360	(98)
Space heating per m2										(98) / (4) =	41.4734	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)											0.0000	(201)
Fraction of space heat from main system(s)											1.0000	(202)
Efficiency of main space heating system 1 (in %)											90.4000	(206)
Efficiency of secondary/supplementary heating system, %											0.0000	(208)
Space heating requirement											5581.0133	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	989.0753	767.8310	641.3666	374.5709	178.7124	0.0000	0.0000	0.0000	0.0000	377.2398	704.1858	1012.2541	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	1094.1099	849.3706	709.4764	414.3484	197.6907	0.0000	0.0000	0.0000	0.0000	417.3007	778.9666	1119.7502	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.3009	88.0797	87.6401	86.6834	84.8169	79.7000	79.7000	79.7000	79.7000	86.6120	87.8597	88.3811	(217)
Fuel for water heating, kWh/month													
	241.0186	212.8160	224.2644	202.7517	202.6885	192.1655	184.0106	202.6664	202.5435	210.4398	219.9854	234.8392	(219)
Water heating fuel used												2530.1896	(219)
Annual totals kWh/year													
Space heating fuel - main system												5581.0133	(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)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 677 * 1.00) =										-800.9817		-800.9817	(233)
Total delivered energy for all uses												7841.9310	(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	5581.0133	0.2160	1205.4989	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2530.1896	0.2160	546.5210	(264)
Space and water heating			1752.0198	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-800.9817	0.5190	-415.7095	(269)
Total CO2, kg/year			1612.2677	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2500	(273)

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

DER		13.2500	ZC1
Total Floor Area	TFA	121.6500	
Assumed number of occupants	N	2.8695	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.9971	ZC2
CO2 emissions from cooking, equation (L16)		1.5443	ZC3
Total CO2 emissions		28.7915	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.7915	ZC8

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3772	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3772	(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	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.9083			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.6285	(36)
Total fabric heat loss					(33) + (36) =		90.5368	(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	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(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												2.8695	(42)
Average daily hot water use (litres/day)												102.3499	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(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													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
Total per year (kWh/year) = Sum(64)m =												2179.9712	(64)
Heat gains from water heating, kWh/month													
	94.2164	83.5099	88.8046	81.1343	80.6147	73.6210	72.2165	77.1604	76.3712	84.0568	86.9618	92.4648	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	126.6350	124.2707	119.3611	112.6865	108.3531	102.2514	97.0652	103.7102	106.0711	112.9795	120.7803	124.2806	(72)
Total internal gains													
	508.8838	506.6098	489.8968	462.6879	434.5915	407.8653	390.7194	397.2740	411.4384	438.8810	470.4448	494.5697	(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	1.0300	10.6334	0.6300	0.7000	0.7700	3.3472	(74)
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	198.7898	348.9801	504.5160	669.5839	789.9697	801.6814	765.6671	673.2969	561.3339	393.0337	240.0048	168.8863	(83)
Total gains	707.6736	855.5899	994.4128	1132.2719	1224.5612	1209.5467	1156.3865	1070.5709	972.7722	831.9147	710.4496	663.4559	(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	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area													
	0.9982	0.9954	0.9870	0.9579	0.8768	0.7169	0.5502	0.6098	0.8505	0.9761	0.9961	0.9987	(86)
MIT	19.5853	19.7698	20.0587	20.4332	20.7493	20.9338	20.9850	20.9761	20.8431	20.4245	19.9367	19.5596	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house													
	0.9976	0.9938	0.9822	0.9415	0.8293	0.6208	0.4212	0.4784	0.7762	0.9638	0.9944	0.9982	(89)
MIT 2	17.9864	18.2577	18.6789	19.2217	19.6424	19.8560	19.8943	19.8923	19.7691	19.2199	18.5120	17.9569	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.2130	18.4720	18.8745	19.3934	19.7992	20.0088	20.0489	20.0459	19.9213	19.3906	18.7139	18.1841	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2130	18.4720	18.8745	19.3934	19.7992	20.0088	20.0489	20.0459	19.9213	19.3906	18.7139	18.1841	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9907	0.9762	0.9321	0.8248	0.6312	0.4394	0.4967	0.7783	0.9560	0.9917	0.9971	(94)
Useful gains	704.9456	847.6467	970.7238	1055.3841	1010.0584	763.4831	508.1575	531.7401	757.1538	795.3103	704.5493	661.5473	(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													
	2148.3708	2089.3948	1899.3888	1588.1495	1222.5452	806.3211	514.1534	542.2604	872.0143	1326.9067	1762.4938	2134.0617	(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													
	1073.9084	834.4548	690.9268	383.5911	158.0902	0.0000	0.0000	0.0000	0.0000	395.5077	761.7200	1095.5508	(98)
Space heating												5393.7496	(98)
Space heating per m2											(98) / (4) =	44.3383	(99)

CALCULATION OF TARGET EMISSIONS 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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5768.7162	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1073.9084	834.4548	690.9268	383.5911	158.0902	0.0000	0.0000	0.0000	0.0000	395.5077	761.7200	1095.5508	(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)													
	1148.5651	892.4650	738.9591	410.2579	169.0804	0.0000	0.0000	0.0000	0.0000	423.0029	814.6738	1171.7121	(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													
	215.3379	189.7204	199.0618	178.1872	174.4304	155.5910	149.1727	164.0415	163.8623	184.7825	195.7137	210.0697	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5176	88.3066	87.8649	86.8081	84.5528	79.8000	79.8000	79.8000	79.8000	86.7942	88.0857	88.5888	(217)
Fuel for water heating, kWh/month													
	243.2713	214.8428	226.5545	205.2657	206.2976	194.9762	186.9332	205.5657	205.3412	212.8974	222.1856	237.1290	(219)
Water heating fuel used												2561.2603	(219)
Annual totals kWh/year													
Space heating fuel - main system												5768.7162	(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)												456.7098	(232)
Total delivered energy for all uses												8861.6864	(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	5768.7162	0.2160	1246.0427	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2561.2603	0.2160	553.2322	(264)
Space and water heating			1799.2749	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Total CO2, kg/m2/year			2075.2323	(272)
Emissions per m2 for space and water heating			14.7906	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9485	(272b)
Emissions per m2 for pumps and fans			0.3200	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7906 * 1.00) + 1.9485 + 0.3200, rounded to 2 d.p.			17.0600	(273)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.3900	
Infiltration rate		0.3467	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3901	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	62.0162	61.6225	61.2367	59.4242	59.0850	57.5064	57.5064	57.2141	58.1145	59.0850	59.7711	60.4883	(38)
Heat transfer coeff	158.8912	158.4976	158.1117	156.2992	155.9601	154.3814	154.3814	154.0891	154.9895	155.9601	156.6461	157.3633	(39)
Average = Sum(39)m / 12 =												156.2976	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3061	1.3029	1.2997	1.2848	1.2820	1.2691	1.2691	1.2667	1.2741	1.2820	1.2877	1.2936	(40)
HLP (average)												1.2848	(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	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822	(72)
Total internal gains													
	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713	(73)

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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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	230.3939	404.4617	584.7250	776.0358	915.5608	929.1343	887.3945	780.3391	650.5759	455.5191	278.1613	195.7362	(83)
Total gains	657.3295	829.9766	995.2989	1161.8097	1274.8022	1263.8516	1206.8375	1103.9386	987.4877	817.3803	668.7710	609.2074	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9050	31.9843	32.0624	32.4342	32.5047	32.8371	32.8371	32.8994	32.7082	32.5047	32.3623	32.2148	
alpha	3.1270	3.1323	3.1375	3.1623	3.1670	3.1891	3.1891	3.1933	3.1805	3.1670	3.1575	3.1477	
util living area													
	0.9904	0.9798	0.9574	0.9049	0.8066	0.6609	0.5196	0.5759	0.7902	0.9399	0.9832	0.9924	(86)
MIT	18.8296	19.1140	19.5455	20.0846	20.5396	20.8328	20.9429	20.9200	20.6840	20.0690	19.3449	18.7828	(87)
Th 2	19.8360	19.8386	19.8410	19.8527	19.8549	19.8651	19.8651	19.8670	19.8612	19.8549	19.8505	19.8459	(88)
util rest of house													
	0.9882	0.9753	0.9476	0.8822	0.7591	0.5765	0.4023	0.4581	0.7212	0.9210	0.9788	0.9907	(89)
MIT 2	17.8646	18.1483	18.5750	19.1041	19.5233	19.7730	19.8448	19.8358	19.6637	19.1018	18.3882	17.8250	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.0013	18.2851	18.7125	19.2431	19.6673	19.9232	20.0004	19.9895	19.8083	19.2388	18.5238	17.9607	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0013	18.2851	18.7125	19.2431	19.6673	19.9232	20.0004	19.9895	19.8083	19.2388	18.5238	17.9607	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9834	0.9671	0.9352	0.8675	0.7502	0.5812	0.4172	0.4719	0.7175	0.9077	0.9715	0.9867	(94)
Useful gains	646.4026	802.6899	930.8515	1007.9096	956.3590	734.5811	503.4445	520.9568	708.4922	741.9400	649.7303	601.0811	(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													
	2177.0201	2121.5107	1930.9403	1616.6140	1242.5825	821.7970	524.9588	553.0987	884.7261	1347.3138	1789.4966	2165.4309	(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													
	1138.7794	886.2476	744.0661	438.2672	212.9503	0.0000	0.0000	0.0000	0.0000	450.3981	820.6317	1163.8762	(98)
Space heating												5855.2166	(98)
Space heating per m2											(98) / (4) =	48.1317	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	1451.1855	1142.4226	1171.0772	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7954	0.8574	0.8258	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1154.3009	979.5349	967.0634	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1592.6639	1523.4363	1405.3316	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	315.6214	404.6626	326.0715	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1046.3555	(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	78.9053	101.1657	81.5179	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												261.5889	(107)
Space cooling per m2												2.1503	(108)
Energy for space heating												48.1317	(99)
Energy for space cooling												2.1503	(108)
Total												50.2820	(109)
Dwelling Fabric Energy Efficiency (DFEE)												50.3	(109)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3772	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3772	(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	0.4810	0.4715	0.4621	0.4149	0.4055	0.3584	0.3584	0.3489	0.3772	0.4055	0.4244	0.4432	(22b)
Effective ac	0.6157	0.6112	0.6068	0.5861	0.5822	0.5642	0.5642	0.5609	0.5711	0.5822	0.5900	0.5982	(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			2.1300	1.0000	2.1300			(26)
TER Opening Type (Uw = 1.40)			23.8000	1.3258	31.5530			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846			(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.1800	27.2574			(29a)
Plane Ceiling	60.2300		60.2300	0.1300	7.8299			(30)
Bay	1.1800		1.1800	0.1300	0.1534			(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.9083			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.6285	(36)
Total fabric heat loss (33) + (36) =	90.5368	(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	63.8783	63.4124	62.9556	60.8102	60.4088	58.5402	58.5402	58.1942	59.2600	60.4088	61.2208	62.0698	(38)
Heat transfer coeff	154.4152	153.9492	153.4924	151.3470	150.9456	149.0770	149.0770	148.7310	149.7968	150.9456	151.7576	152.6066	(39)
Average = Sum(39)m / 12 =												151.3451	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2693	1.2655	1.2618	1.2441	1.2408	1.2255	1.2255	1.2226	1.2314	1.2408	1.2475	1.2545	(40)
HLP (average)												1.2441	(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	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)
Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	35.4790	31.0302	32.0204	27.9161	26.7862	23.1145	21.4189	24.5785	24.8721	28.9860	31.6405	34.3596	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	143.4735	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.8608	22.9693	18.6799	14.1419	10.5712	8.9247	9.6434	12.5349	16.8243	21.3623	24.9330	26.5796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.3459	290.3277	282.8138	266.8175	246.6251	227.6471	214.9687	211.9869	219.5009	235.4971	255.6895	274.6675	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	37.3474	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	47.6869	46.1759	43.0381	38.7724	36.0030	32.1034	28.7889	33.0357	34.5446	38.9597	43.9452	46.1822	(72)
Total internal gains													
	426.9357	425.5149	410.5739	385.7739	359.2414	334.7173	319.4431	323.5996	336.9118	361.8612	390.6097	413.4713	(73)

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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	1.0300	10.6334	0.6300	0.7000	0.7700	3.3472	(74)
Northeast	7.0800	11.2829	0.6300	0.7000	0.7700	24.4134	(75)
Southeast	6.5000	36.7938	0.6300	0.7000	0.7700	73.0904	(77)
Southwest	8.1600	36.7938	0.6300	0.7000	0.7700	91.7565	(79)
West	1.0300	19.6403	0.6300	0.7000	0.7700	6.1824	(80)

Solar gains	198.7898	348.9801	504.5160	669.5839	789.9697	801.6814	765.6671	673.2969	561.3339	393.0337	240.0048	168.8863	(83)
Total gains	625.7255	774.4950	915.0898	1055.3578	1149.2111	1136.3986	1085.1102	996.8965	898.2456	754.8949	630.6145	582.3575	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.7091	54.8747	55.0380	55.8182	55.9666	56.6681	56.6681	56.8000	56.3958	55.9666	55.6672	55.3575	
alpha	4.6473	4.6583	4.6692	4.7212	4.7311	4.7779	4.7779	4.7867	4.7597	4.7311	4.7111	4.6905	
util living area													
	0.9989	0.9969	0.9907	0.9672	0.8969	0.7477	0.5817	0.6462	0.8789	0.9835	0.9976	0.9993	(86)
MIT	19.5238	19.7097	20.0019	20.3848	20.7166	20.9205	20.9811	20.9696	20.8143	20.3716	19.8771	19.4985	(87)
Th 2	19.8649	19.8680	19.8709	19.8849	19.8875	19.8997	19.8997	19.9020	19.8950	19.8875	19.8822	19.8767	(88)
util rest of house													
	0.9986	0.9959	0.9871	0.9538	0.8541	0.6527	0.4476	0.5110	0.8120	0.9746	0.9966	0.9990	(89)
MIT 2	18.5210	18.7088	19.0015	19.3870	19.6943	19.8629	19.8950	19.8933	19.7894	19.3815	18.8875	18.5050	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	18.6631	18.8507	19.1433	19.5284	19.8392	20.0128	20.0489	20.0458	19.9347	19.5219	19.0277	18.6458	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6631	18.8507	19.1433	19.5284	19.8392	20.0128	20.0489	20.0458	19.9347	19.5219	19.0277	18.6458	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9945	0.9840	0.9483	0.8519	0.6635	0.4667	0.5301	0.8149	0.9705	0.9955	0.9986	(94)
Useful gains	624.4699	770.2025	900.4268	1000.8471	979.0012	754.0394	506.4207	528.4289	731.9735	732.6370	627.7479	581.5248	(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													
	2217.8847	2147.6940	1940.6521	1608.5835	1228.5798	806.9208	514.1510	542.2444	874.0172	1346.7148	1810.1255	2204.5197	(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													
	1185.5006	925.6743	773.9276	437.5703	185.6865	0.0000	0.0000	0.0000	0.0000	456.8739	851.3119	1207.5082	(98)
Space heating												6024.0532	(98)
Space heating per m2											(98) / (4) =	49.5195	(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	1401.3242	1103.1701	1130.3557	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8390	0.9054	0.8744	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1175.7201	998.8104	988.3481	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1443.6928	1381.1575	1280.2174	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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000   192.9403   284.4663   217.1508     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          694.5574 (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    48.2351    71.1166    54.2877     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          173.6394 (107)
Space cooling per m2                                                                                                                     1.4274 (108)
Energy for space heating                                                                                                                49.5195 (99)
Energy for space cooling                                                                                                                 1.4274 (108)
Total                                                                                                                                   50.9469 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                     58.6 (109)


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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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.3900	
Infiltration rate			0.3467	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3467	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3641	0.3381	0.3467	0.3294	0.3294	0.3207	0.3120	0.3034	0.2947	0.3207	0.3034	0.3207	(22b)
Effective ac	0.5663	0.5571	0.5601	0.5542	0.5542	0.5514	0.5487	0.5460	0.5434	0.5514	0.5460	0.5514	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	58.7537	57.8066	58.1145	57.5064	57.5064	57.2141	56.9295	56.6528	56.3838	57.2141	56.6528	57.2141	(38)
Heat transfer coeff	155.6287	154.6816	154.9895	154.3814	154.3814	154.0891	153.8046	153.5278	153.2589	154.0891	153.5278	154.0891	(39)
Average = Sum(39)m / 12 =												154.2041	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2793	1.2715	1.2741	1.2691	1.2691	1.2667	1.2643	1.2620	1.2598	1.2667	1.2620	1.2667	(40)
HLP (average)												1.2676	(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	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
RHI water heating demand												2150	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	285.3565	427.2954	625.8335	841.3469	947.8691	1046.6906	991.1351	889.9383	737.3904	520.0411	343.5787	238.2113	(83)
Total gains	1018.2880	1155.0844	1326.7745	1500.3932	1563.5175	1623.7955	1545.9277	1454.1541	1325.9056	1150.6847	1021.0876	951.6622	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5739	32.7733	32.7082	32.8371	32.8371	32.8994	32.9602	33.0196	33.0776	32.8994	33.0196	32.8994	
alpha	3.1716	3.1849	3.1805	3.1891	3.1891	3.1933	3.1973	3.2013	3.2052	3.1933	3.2013	3.1933	
util living area													
	0.9650	0.9485	0.9068	0.8210	0.6909	0.5031	0.3763	0.3973	0.6310	0.8471	0.9403	0.9701	(86)
MIT	19.3380	19.5425	19.9435	20.4052	20.7462	20.9329	20.9801	20.9769	20.8586	20.4476	19.8478	19.3114	(87)
Th 2	19.8571	19.8632	19.8612	19.8651	19.8651	19.8670	19.8689	19.8707	19.8724	19.8670	19.8707	19.8670	(88)
util rest of house													
	0.9578	0.9382	0.8879	0.7852	0.6297	0.4159	0.2722	0.2885	0.5456	0.8070	0.9260	0.9637	(89)
MIT 2	17.6953	17.9909	18.5563	19.1887	19.6208	19.8214	19.8608	19.8612	19.7612	19.2639	18.4381	17.6641	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.9281	18.2108	18.7529	19.3611	19.7803	19.9789	20.0195	20.0193	19.9167	19.4316	18.6379	17.8975	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7781	18.0608	18.6029	19.2111	19.6303	19.8289	19.8695	19.8693	19.7667	19.2816	18.4879	17.7475	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9389	0.9158	0.8615	0.7610	0.6157	0.4128	0.2723	0.2883	0.5368	0.7816	0.9022	0.9465	(94)
Useful gains	956.1070	1057.7880	1142.9764	1141.7806	962.6290	670.2237	420.9269	419.2607	711.7805	899.4290	921.2306	900.7222	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2004.2003	1973.8556	1798.3305	1499.2122	1100.7840	697.8547	425.9546	425.1651	776.5140	1214.4737	1625.5299	1964.2561	(97)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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												
	779.7814	615.5974	487.5834	257.3508	102.7873	0.0000	0.0000	0.0000	0.0000	234.3933	507.0955	791.2692 (98)
Space heating												3775.8584 (98)
RHI space heating demand												3776 (98)

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.3900	
Infiltration rate			0.3467	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3901	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	62.0162	61.6225	61.2367	59.4242	59.0850	57.5064	57.5064	57.2141	58.1145	59.0850	59.7711	60.4883	(38)
Heat transfer coeff	158.8912	158.4976	158.1117	156.2992	155.9601	154.3814	154.3814	154.0891	154.9895	155.9601	156.6461	157.3633	(39)
Average = Sum(39)m / 12 =												156.2976	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3061	1.3029	1.2997	1.2848	1.2820	1.2691	1.2691	1.2667	1.2741	1.2820	1.2877	1.2936	(40)
HLP (average)												1.2848	(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	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	230.3939	404.4617	584.7250	776.0358	915.5608	929.1343	887.3945	780.3391	650.5759	455.5191	278.1613	195.7362	(83)
Total gains	963.3254	1132.2506	1285.6659	1435.0821	1531.2092	1506.2393	1442.1870	1344.5549	1239.0910	1086.1626	955.6702	909.1871	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9050	31.9843	32.0624	32.4342	32.5047	32.8371	32.8371	32.8994	32.7082	32.5047	32.3623	32.2148	
alpha	3.1270	3.1323	3.1375	3.1623	3.1670	3.1891	3.1891	3.1933	3.1805	3.1670	3.1575	3.1477	
util living area													
	0.9728	0.9548	0.9213	0.8525	0.7390	0.5850	0.4474	0.4925	0.7021	0.8857	0.9569	0.9769	(86)
MIT	19.1397	19.4046	19.7969	20.2722	20.6523	20.8831	20.9628	20.9490	20.7821	20.2803	19.6247	19.0912	(87)
Th 2	19.8360	19.8386	19.8410	19.8527	19.8549	19.8651	19.8651	19.8670	19.8612	19.8549	19.8505	19.8459	(88)
util rest of house													
	0.9672	0.9457	0.9052	0.8220	0.6855	0.5021	0.3415	0.3845	0.6254	0.8551	0.9466	0.9721	(89)
MIT 2	17.3963	17.7779	18.3374	19.0032	19.4999	19.7744	19.8465	19.8394	19.6724	19.0330	18.1077	17.3324	(90)
Living area fraction										fLA = Living area / (4) =		0.1417	(91)
MIT	17.6434	18.0084	18.5443	19.1830	19.6632	19.9315	20.0047	19.9966	19.8296	19.2097	18.3227	17.5817	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4934	17.8584	18.3943	19.0330	19.5132	19.7815	19.8547	19.8466	19.6796	19.0597	18.1727	17.4317	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9505	0.9240	0.8790	0.7958	0.6674	0.4955	0.3404	0.3824	0.6116	0.8281	0.9254	0.9571	(94)
Useful gains	915.6259	1046.2381	1130.0796	1142.0085	1021.9317	746.3008	490.9865	514.1973	757.7667	899.4523	884.3411	870.2018	(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													
	2096.3168	2053.8827	1880.6234	1583.7808	1218.5542	799.9345	502.4683	531.0877	864.7843	1319.3813	1734.4996	2082.1761	(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)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating kWh

878.4341	677.1371	558.4046	318.0761	146.2871	0.0000	0.0000	0.0000	0.0000	312.4272	612.1141	901.7089	(98)

Space heating 4404.5891 (98)
Space heating per m2 (98) / (4) = 36.2071 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4872.3331 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	878.4341	677.1371	558.4046	318.0761	146.2871	0.0000	0.0000	0.0000	0.0000	312.4272	612.1141	901.7089	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	971.7191	749.0455	617.7042	351.8541	161.8220	0.0000	0.0000	0.0000	0.0000	345.6053	677.1174	997.4656	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.0935	87.8431	87.3471	86.2776	84.2865	79.7000	79.7000	79.7000	79.7000	86.1392	87.5784	88.1848	(217)
Fuel for water heating, kWh/month													
	241.5861	213.3890	225.0168	203.7053	203.9641	192.1655	184.0106	202.6664	202.5435	211.5951	220.6921	235.3619	(219)
Water heating fuel used												2536.6963	(219)
Annual totals kWh/year													
Space heating fuel - main system												4872.3331	(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)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 677 * 1.00) =										-800.9817		-800.9817	(233)
Total delivered energy for all uses												7139.7576	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4872.3331	3.4800	169.5572	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2536.6963	3.4800	88.2770	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-800.9817	13.1900	-105.6495	(252)
Total energy cost			342.3173	(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] = 0.8627 (257)
SAP value 87.9650
SAP rating (Section 12) 88 (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	4872.3331	0.2160	1052.4240	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2536.6963	0.2160	547.9264	(264)
Space and water heating			1600.3504	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-800.9817	0.5190	-415.7095	(269)
Total kg/year			1460.5982	(272)
CO2 emissions per m2			12.0100	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	88.2556
EI rating	88 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9040 = 3.850, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9040 = 0.2389, stars = 4
Water heating energy efficiency	3.48 / 0.8455 = 4.116, stars = 4
Water heating environmental impact	0.216 / 0.8455 = 0.2555, stars = 4

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1272	(8)
Pressure test		Yes	
Measured/design AP50		4.3900	
Infiltration rate		0.3467	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3467	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3641	0.3381	0.3467	0.3294	0.3294	0.3207	0.3120	0.3034	0.2947	0.3207	0.3034	0.3207	(22b)
Effective ac	0.5663	0.5571	0.5601	0.5542	0.5542	0.5514	0.5487	0.5460	0.5434	0.5514	0.5460	0.5514	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	58.7537	57.8066	58.1145	57.5064	57.5064	57.2141	56.9295	56.6528	56.3838	57.2141	56.6528	57.2141	(38)
Heat transfer coeff	155.6287	154.6816	154.9895	154.3814	154.3814	154.0891	153.8046	153.5278	153.2589	154.0891	153.5278	154.0891	(39)
Average = Sum(39)m / 12 =												154.2041	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2793	1.2715	1.2741	1.2691	1.2691	1.2667	1.2643	1.2620	1.2598	1.2667	1.2620	1.2667	(40)
HLP (average)												1.2676	(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	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

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

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7290	(55)
Total storage loss													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(56)
If cylinder contains dedicated solar storage													
	22.5990	20.4120	22.5990	21.8700	22.5990	21.8700	22.5990	22.5990	21.8700	22.5990	21.8700	22.5990	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
									Total per year (kWh/year) = Sum(64)m =			2150.3437	(64)
Heat gains from water heating, kWh/month													
	92.2034	81.6917	86.7916	79.1862	78.6016	71.6729	70.2035	75.1473	74.4231	82.0437	85.0137	90.4517	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	123.9293	121.5650	116.6554	109.9808	105.6474	99.5457	94.3595	101.0045	103.3654	110.2738	118.0746	121.5749	(72)
Total internal gains													
	732.9315	727.7889	700.9410	659.0463	615.6484	577.1050	554.7926	564.2158	588.5151	630.6436	677.5089	713.4509	(73)

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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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	285.3565	427.2954	625.8335	841.3469	947.8691	1046.6906	991.1351	889.9383	737.3904	520.0411	343.5787	238.2113	(83)
Total gains	1018.2880	1155.0844	1326.7745	1500.3932	1563.5175	1623.7955	1545.9277	1454.1541	1325.9056	1150.6847	1021.0876	951.6622	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5739	32.7733	32.7082	32.8371	32.8371	32.8994	32.9602	33.0196	33.0776	32.8994	33.0196	32.8994	
alpha	3.1716	3.1849	3.1805	3.1891	3.1891	3.1933	3.1973	3.2013	3.2052	3.1933	3.2013	3.1933	
util living area													
	0.9650	0.9485	0.9068	0.8210	0.6909	0.5031	0.3763	0.3973	0.6310	0.8471	0.9403	0.9701	(86)
MIT	19.3380	19.5425	19.9435	20.4052	20.7462	20.9329	20.9801	20.9769	20.8586	20.4476	19.8478	19.3114	(87)
Th 2	19.8571	19.8632	19.8612	19.8651	19.8651	19.8670	19.8689	19.8707	19.8724	19.8670	19.8707	19.8670	(88)
util rest of house													
	0.9578	0.9382	0.8879	0.7852	0.6297	0.4159	0.2722	0.2885	0.5456	0.8070	0.9260	0.9637	(89)
MIT 2	17.6953	17.9909	18.5563	19.1887	19.6208	19.8214	19.8608	19.8612	19.7612	19.2639	18.4381	17.6641	(90)
Living area fraction									fLA = Living area / (4) =			0.1417	(91)
MIT	17.9281	18.2108	18.7529	19.3611	19.7803	19.9789	20.0195	20.0193	19.9167	19.4316	18.6379	17.8975	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7781	18.0608	18.6029	19.2111	19.6303	19.8289	19.8695	19.8693	19.7667	19.2816	18.4879	17.7475	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9389	0.9158	0.8615	0.7610	0.6157	0.4128	0.2723	0.2883	0.5368	0.7816	0.9022	0.9465	(94)
Useful gains	956.1070	1057.7880	1142.9764	1141.7806	962.6290	670.2237	420.9269	419.2607	711.7805	899.4290	921.2306	900.7222	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	2004.2003	1973.8556	1798.3305	1499.2122	1100.7840	697.8547	425.9546	425.1651	776.5140	1214.4737	1625.5299	1964.2561	(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)

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

Space heating kWh
779.7814 615.5974 487.5834 257.3508 102.7873 0.0000 0.0000 0.0000 0.0000 234.3933 507.0955 791.2692 (98)
Space heating 3775.8584 (98)
Space heating per m2 (98) / (4) = 31.0387 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 90.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 4176.8345 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	779.7814	615.5974	487.5834	257.3508	102.7873	0.0000	0.0000	0.0000	0.0000	234.3933	507.0955	791.2692	(98)
Space heating efficiency (main heating system 1)													
	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)													
	862.5900	680.9706	539.3622	284.6800	113.7028	0.0000	0.0000	0.0000	0.0000	259.2846	560.9464	875.2978	(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													
	212.8216	187.4476	196.5455	175.7521	171.9141	153.1559	146.6564	161.5252	161.4271	182.2662	193.2785	207.5534	(64)
Efficiency of water heater												79.7000	(216)
(217)m	87.8706	87.6532	87.0428	85.7295	83.3934	79.7000	79.7000	79.7000	79.7000	85.3854	87.1704	87.9465	(217)
Fuel for water heating, kWh/month													
	242.1987	213.8515	225.8034	205.0077	206.1484	192.1655	184.0106	202.6664	202.5435	213.4629	221.7250	235.9996	(219)
Water heating fuel used												2545.5833	(219)
Annual totals kWh/year													
Space heating fuel - main system												4176.8345	(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)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 781 * 1.00) =										-924.2935		-924.2935	(233)
Total delivered energy for all uses												6329.8341	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4176.8345	10.2300	427.2902	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2545.5833	10.2300	260.4132	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	456.7098	36.7200	167.7039	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-924.2935	36.7200	-339.4006	(252)
Total energy cost			646.5466	(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	4176.8345	0.2160	902.1962	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.5833	0.2160	549.8460	(264)
Space and water heating			1452.0422	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-924.2935	0.5190	-479.7083	(269)
Total kg/year			1248.2913	(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	4176.8345	1.2200	5095.7381	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2545.5833	1.2200	3105.6116	(264)
Space and water heating			8201.3497	(265)

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

Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	456.7098	3.0700	1402.0992 (268)
Energy saving/generation technologies			
PV Unit	-924.2935	3.0700	-2837.5812 (269)
Primary energy kWh/year			6996.1177 (272)
Primary energy kWh/m2/year			57.5102 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 88

(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	+ 1.4	-£ 120	-265 kg (21.3%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£120	2.18 kg/m²	B 89	B 90
	Total Savings	£120	2.18 kg/m²		

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

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
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	£195	£214	-£18
Mains gas	£791	£653	£138
Space heating	£558	£561	-£3
Water heating	£260	£138	£123
Lighting	£168	£168	£0
Generated (PV)	-£339	-£339	£0
Total cost of fuels	£647	£528	£120
Total cost of uses	£647	£528	£120
Delivered energy	52 kWh/m²	41 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.2 tonnes	1.0 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	58 kWh/m²	45 kWh/m²	12 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.3900	
Infiltration rate			0.3467	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3467	(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	0.4421	0.4334	0.4247	0.3814	0.3727	0.3294	0.3294	0.3207	0.3467	0.3727	0.3901	0.4074	(22b)
Effective ac	0.5977	0.5939	0.5902	0.5727	0.5695	0.5542	0.5542	0.5514	0.5601	0.5695	0.5761	0.5830	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0513	(36)
Total fabric heat loss					(33) + (36) =		96.8750	(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	62.0162	61.6225	61.2367	59.4242	59.0850	57.5064	57.5064	57.2141	58.1145	59.0850	59.7711	60.4883	(38)
Heat transfer coeff	158.8912	158.4976	158.1117	156.2992	155.9601	154.3814	154.3814	154.0891	154.9895	155.9601	156.6461	157.3633	(39)
Average = Sum(39)m / 12 =												156.2976	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3061	1.3029	1.2997	1.2848	1.2820	1.2691	1.2691	1.2667	1.2741	1.2820	1.2877	1.2936	(40)
HLP (average)												1.2848	(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	2.8695	(42)
Average daily hot water use (litres/day)	102.3499	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920	(45)
Energy content (annual)										Total = Sum(45)m =		1610.3627	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538	(46)
Water storage loss:													
Store volume												190.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7851	(55)
Total storage loss													
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384	(56)
If cylinder contains dedicated solar storage													
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311	(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													
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856	(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												1.1262	(H8)
Utilisation factor												0.5885	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												109.5000	(H13)
Daily hot water demand												102.3499	(H14)
Volume ratio Veff/V												1.0699	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-938.4673	(H17)
Solar input	-27.2137	-45.4118	-77.3415	-103.6529	-128.0544	-125.8979	-124.2341	-108.5439	-85.0117	-58.0530	-32.2793	-22.7732	(63)
										Solar input (sum of months) = Sum(63)m =		-938.4673	(63)
Output from w/h													
	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123	(64)
										Total per year (kWh/year) = Sum(64)m =		1053.7664	(64)
Heat gains from water heating, kWh/month													
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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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	1.0300	10.6334	0.4600	0.0000	0.7700	3.8793	(74)
Northeast	7.0800	11.2829	0.4600	0.0000	0.7700	28.2946	(75)
Southeast	6.5000	36.7938	0.4600	0.0000	0.7700	84.7104	(77)
Southwest	1.5000	36.7938	0.4600	0.0000	0.7700	19.5486	(79)
West	1.0300	19.6403	0.4600	0.0000	0.7700	7.1653	(80)
Southwest	6.6600	36.7938	0.4600	0.0000	0.7700	86.7956	(79)

Solar gains	230.3939	404.4617	584.7250	776.0358	915.5608	929.1343	887.3945	780.3391	650.5759	455.5191	278.1613	195.7362	(83)
Total gains	954.8653	1123.7906	1275.7051	1419.1181	1508.9918	1483.7718	1419.7195	1323.0879	1224.6278	1076.2018	947.2101	900.7270	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.9050	31.9843	32.0624	32.4342	32.5047	32.8371	32.8371	32.8994	32.7082	32.5047	32.3623	32.2148	
alpha	3.1270	3.1323	3.1375	3.1623	3.1670	3.1891	3.1891	3.1933	3.1805	3.1670	3.1575	3.1477	
util living area													
	0.9734	0.9556	0.9227	0.8557	0.7448	0.5915	0.4535	0.4992	0.7070	0.8879	0.9579	0.9775	(86)
MIT	19.1314	19.3968	19.7889	20.2623	20.6438	20.8793	20.9613	20.9470	20.7775	20.2733	19.6169	19.0827	(87)
Th 2	19.8360	19.8386	19.8410	19.8527	19.8549	19.8651	19.8651	19.8670	19.8612	19.8549	19.8505	19.8459	(88)
util rest of house													
	0.9679	0.9466	0.9068	0.8256	0.6916	0.5083	0.3465	0.3902	0.6305	0.8577	0.9478	0.9728	(89)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT 2	17.3845	17.7670	18.3264	18.9904	19.4903	19.7712	19.8457	19.8382	19.6678	19.0238	18.0967	17.3203	(90)
Living area fraction										fLA = Living area / (4) =		0.1417	(91)
MIT	17.6320	17.9979	18.5336	19.1706	19.6538	19.9282	20.0038	19.9953	19.8251	19.2009	18.3121	17.5700	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4820	17.8479	18.3836	19.0206	19.5038	19.7782	19.8538	19.8453	19.6751	19.0509	18.1621	17.4200	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9514	0.9252	0.8807	0.7993	0.6731	0.5014	0.3454	0.3880	0.6163	0.8307	0.9267	0.9580	(94)
Useful gains	908.4992	1039.7200	1123.5000	1134.2335	1015.6811	743.9628	490.3622	513.2925	754.7173	893.9798	877.7995	862.9183	(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	2094.5116	2052.2174	1878.9391	1581.8455	1217.0829	799.4187	502.3292	530.8868	864.0805	1318.0034	1732.8416	2080.3503	(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	882.3932	680.3983	562.0466	322.2807	149.8429	0.0000	0.0000	0.0000	0.0000	315.4736	615.6303	905.7695	(98)
Space heating												4433.8351	(98)
Space heating per m2											(98) / (4) =	36.4475	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4904.6849	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	882.3932	680.3983	562.0466	322.2807	149.8429	0.0000	0.0000	0.0000	0.0000	315.4736	615.6303	905.7695	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	976.0987	752.6530	621.7330	356.5051	165.7555	0.0000	0.0000	0.0000	0.0000	348.9752	681.0070	1001.9574	(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	177.7400	134.9294	109.9404	57.7316	23.1976	7.0373	1.5275	33.0169	63.3986	114.9497	153.3851	176.9123	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.4100	88.4352	88.4571	88.5931	88.8018	79.7000	79.7000	79.7000	79.7000	87.2710	88.0424	88.4594	(217)
Fuel for water heating, kWh/month	201.0406	152.5743	124.2867	65.1649	26.1229	8.8297	1.9166	41.4265	79.5465	131.7158	174.2173	199.9926	(219)
Water heating fuel used												1206.8345	(219)
Annual totals kWh/year													
Space heating fuel - main system												4904.6849	(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)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 677 * 1.00) =										-800.9817		-800.9817	(233)
Total delivered energy for all uses												5892.2474	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4904.6849	3.4800	170.6830	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1206.8345	3.4800	41.9978	(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	456.7098	13.1900	60.2400	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-800.9817	13.1900	-105.6495	(252)
Total energy cost			303.7589	(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] =	0.7655	(257)
SAP value		89.3206	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	4904.6849	0.2160	1059.4119	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1206.8345	0.2160	260.6762	(264)
Space and water heating			1320.0882	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-800.9817	0.5190	-415.7095	(269)
Total kg/year			1206.2861	(272)
CO2 emissions per m2			9.9200	(273)
EI value			90.3005	
EI rating			90	(274)
EI band			B	

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.4200	(1b)	x 2.5400	(2b) =	156.0068	(1b) - (3b)
First floor	60.2300	(1c)	x 2.6300	(2c) =	158.4049	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.6500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		314.4117	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1272	(8)
Pressure test			Yes	
Measured/design AP50			4.3900	
Infiltration rate			0.3467	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3467	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3641	0.3381	0.3467	0.3294	0.3294	0.3207	0.3120	0.3034	0.2947	0.3207	0.3034	0.3207	(22b)
Effective ac	0.5663	0.5571	0.5601	0.5542	0.5542	0.5514	0.5487	0.5460	0.5434	0.5514	0.5460	0.5514	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1300	1.3000	2.7690			(26)
Window (Uw = 1.30)			17.1400	1.2357	21.1806			(27)
French Door (Uw = 1.30)			6.6600	1.2357	8.2300			(27)
GF B&B J150 P/A=0.60			61.4200	0.1300	7.9846	75.0000	4606.5000	(28a)
EW Brick AAC015	177.3600	25.9300	151.4300	0.2500	37.8575	52.3000	7919.7890	(29a)
Plane Ceiling	60.2300		60.2300	0.1600	9.6368	9.0000	542.0700	(30)
Bay	1.1800		1.1800	0.1400	0.1652	9.0000	10.6200	(30)
Total net area of external elements Aum(A, m2)			300.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		87.8237			(33)
GF Timber			40.9400			9.0000	368.4600	(32c)
1F Timber			114.5900			9.0000	1031.3100	(32c)
GF Masonry			55.0000			39.0000	2145.0000	(32c)
Internal Floor			60.2300			18.0000	1084.1400	(32d)
Internal Ceiling			60.2300			9.0000	542.0700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18249.9590	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	150.0202	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0513	(36)
Total fabric heat loss	(33) + (36) = 96.8750	(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	58.7537	57.8066	58.1145	57.5064	57.5064	57.2141	56.9295	56.6528	56.3838	57.2141	56.6528	57.2141	(38)
Heat transfer coeff	155.6287	154.6816	154.9895	154.3814	154.3814	154.0891	153.8046	153.5278	153.2589	154.0891	153.5278	154.0891	(39)
Average = Sum(39)m / 12 =												154.2041	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2793	1.2715	1.2741	1.2691	1.2691	1.2667	1.2643	1.2620	1.2598	1.2667	1.2620	1.2667	(40)
HLP (average)												1.2676	(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	2.8695 (42)
Average daily hot water use (litres/day)	102.3499 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.5849	108.4909	104.3969	100.3029	96.2089	92.1149	92.1149	96.2089	100.3029	104.3969	108.4909	112.5849	(44)

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

Energy conte	166.9602	146.0244	150.6841	131.3701	126.0527	108.7739	100.7950	115.6638	117.0451	136.4048	148.8965	161.6920 (45)
Energy content (annual)										Total = Sum(45)m =		1610.3627 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.0440	21.9037	22.6026	19.7055	18.9079	16.3161	15.1193	17.3496	17.5568	20.4607	22.3345	24.2538 (46)
Water storage loss:												
Store volume												190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4539 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7851 (55)
Total storage loss												
	24.3384	21.9831	24.3384	23.5533	24.3384	23.5533	24.3384	24.3384	23.5533	24.3384	23.5533	24.3384 (56)
If cylinder contains dedicated solar storage												
	14.7311	13.3056	14.7311	14.2559	14.7311	14.2559	14.7311	14.7311	14.2559	14.7311	14.2559	14.7311 (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												
	204.9537	180.3412	187.2819	161.3844	151.2519	132.9351	125.7616	141.5609	148.4102	173.0026	185.6645	199.6856 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2604 (H8)
Utilisation factor												0.5477 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												109.5000 (H13)
Daily hot water demand												102.3499 (H14)
Volume ratio Veff/V												1.0699 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-977.4719 (H17)
Solar input	-31.8875	-45.3420	-77.9320	-105.1483	-123.5030	-131.9207	-129.1464	-115.5899	-90.4989	-62.5679	-37.7145	-26.2208 (63)
										Solar input (sum of months) = Sum(63)m =		-977.4719 (63)
Output from w/h												
	173.0662	134.9992	109.3499	56.2361	27.7489	1.0144	0.0000	25.9709	57.9113	110.4348	147.9500	173.4648 (64)
										Total per year (kWh/year) = Sum(64)m =		1018.1465 (64)
Heat gains from water heating, kWh/month												
	85.9091	76.0065	79.3807	67.6920	62.0719	55.4963	53.4876	59.1759	64.0096	74.6329	78.9225	84.1574 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	172.1682	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.6520	57.4233	46.6998	35.3547	26.4281	22.3117	24.1086	31.3373	42.0608	53.4058	62.3325	66.4489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	428.8745	433.3249	422.1101	398.2351	368.0972	339.7719	320.8488	316.3984	327.6132	351.4882	381.6261	409.9514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	55.0863	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	-114.7788	(71)
Water heating gains (Table 5)													
	115.4692	113.1049	106.6945	94.0167	83.4300	77.0782	71.8920	79.5375	88.9022	100.3130	109.6145	113.1148	(72)
Total internal gains													
	724.4714	719.3289	690.9801	643.0823	593.4310	554.6375	532.3250	542.7488	574.0519	620.6827	669.0488	704.9908	(73)

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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	1.0300	13.4839	0.4600	0.0000	0.7700	4.9193	(74)
Northeast	7.0800	14.6176	0.4600	0.0000	0.7700	36.6572	(75)
Southeast	6.5000	45.1778	0.4600	0.0000	0.7700	104.0129	(77)
Southwest	1.5000	45.1778	0.4600	0.0000	0.7700	24.0030	(79)
West	1.0300	25.1925	0.4600	0.0000	0.7700	9.1909	(80)
Southwest	6.6600	45.1778	0.4600	0.0000	0.7700	106.5732	(79)

Solar gains	285.3565	427.2954	625.8335	841.3469	947.8691	1046.6906	991.1351	889.9383	737.3904	520.0411	343.5787	238.2113 (83)
Total gains	1009.8279	1146.6243	1316.8136	1484.4292	1541.3001	1601.3280	1523.4602	1432.6871	1311.4423	1140.7238	1012.6275	943.2021 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.5739	32.7733	32.7082	32.8371	32.8371	32.8994	32.9602	33.0196	33.0776	32.8994	33.0196	32.8994	
alpha	3.1716	3.1849	3.1805	3.1891	3.1891	3.1933	3.1973	3.2013	3.2052	3.1933	3.2013	3.1933	
util living area													
	0.9658	0.9495	0.9084	0.8245	0.6969	0.5089	0.3814	0.4026	0.6357	0.8496	0.9415	0.9708	(86)
MIT	19.3299	19.5348	19.9359	20.3965	20.7395	20.9306	20.9794	20.9760	20.8554	20.4415	19.8404	19.3031	(87)
Th 2	19.8571	19.8632	19.8612	19.8651	19.8651	19.8670	19.8689	19.8707	19.8724	19.8670	19.8707	19.8670	(88)
util rest of house													
	0.9587	0.9392	0.8897	0.7890	0.6359	0.4210	0.2761	0.2926	0.5503	0.8099	0.9275	0.9646	(89)

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

MIT 2	17.6838	17.9802	18.5459	19.1778	19.6137	19.8197	19.8605	19.8608	19.7584	19.2564	18.4278	17.6523 (90)
Living area fraction										fLA = Living area / (4) =		0.1417 (91)
MIT	17.9170	18.2005	18.7429	19.3505	19.7732	19.9772	20.0190	20.0188	19.9138	19.4244	18.6280	17.8862 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7670	18.0505	18.5929	19.2005	19.6232	19.8272	19.8690	19.8688	19.7638	19.2744	18.4780	17.7362 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9400	0.9170	0.8633	0.7646	0.6215	0.4178	0.2761	0.2924	0.5413	0.7845	0.9038	0.9475	(94)
Useful gains	949.2638	1051.4681	1136.8145	1135.0424	957.8481	668.9922	420.6548	418.9397	709.8263	894.8668	915.2021	893.7071	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	2002.4822	1972.2656	1796.7790	1497.5735	1099.6915	697.5872	425.8925	425.0919	776.0780	1213.3524	1624.0177	1962.5127	(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	783.5945	618.7760	491.0136	261.0224	105.5315	0.0000	0.0000	0.0000	0.0000	236.9532	510.3472	795.1913	(98)
Space heating												3802.4297	(98)
Space heating per m2											(98) / (4) =	31.2571	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4206.2275	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	783.5945	618.7760	491.0136	261.0224	105.5315	0.0000	0.0000	0.0000	0.0000	236.9532	510.3472	795.1913	(98)
Space heating efficiency (main heating system 1)	90.4000	90.4000	90.4000	90.4000	90.4000	0.0000	0.0000	0.0000	0.0000	90.4000	90.4000	90.4000	(210)
Space heating fuel (main heating system)	866.8081	684.4867	543.1566	288.7416	116.7384	0.0000	0.0000	0.0000	0.0000	262.1164	564.5434	879.6364	(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	173.0662	134.9992	109.3499	56.2361	27.7489	1.0144	0.0000	25.9709	57.9113	110.4348	147.9500	173.4648	(64)
Efficiency of water heater												79.7000	(216)
(217)m	88.2565	88.2774	88.2422	88.2987	87.9419	79.7000	79.7000	79.7000	79.7000	86.6997	87.7523	88.2776	(217)
Fuel for water heating, kWh/month	196.0946	152.9261	123.9202	63.6885	31.5537	1.2728	0.0000	32.5858	72.6616	127.3762	168.5996	196.4991	(219)
Water heating fuel used												1167.1782	(219)
Annual totals kWh/year													
Space heating fuel - main system												4206.2275	(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)												456.7098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.48 * 781 * 1.00) =										-924.2935		-924.2935	(233)
Total delivered energy for all uses												5030.8220	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4206.2275	10.2300	430.2971	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1167.1782	10.2300	119.4023	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	456.7098	36.7200	167.7039	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-924.2935	36.7200	-339.4006	(252)
Total energy cost			526.9027	(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	4206.2275	0.2160	908.5451	(261)

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

Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1167.1782	0.2160	252.1105	(264)
Space and water heating			1160.6556	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	456.7098	0.5190	237.0324	(268)
Energy saving/generation technologies				
PV Unit	-924.2935	0.5190	-479.7083	(269)
Total kg/year			982.8547	(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	4206.2275	1.2200	5131.5976	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1167.1782	1.2200	1423.9574	(264)
Space and water heating			6555.5550	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	456.7098	3.0700	1402.0992	(268)
Energy saving/generation technologies				
PV Unit	-924.2935	3.0700	-2837.5812	(269)
Primary energy kWh/year			5503.8230	(272)
Primary energy kWh/m2/year			45.2431	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	150.0 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		415.02 (P1)
Transmission heat loss coefficient		96.88 (37)
Summer heat loss coefficient		511.90 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.0300	87.1704	0.4600	0.0000	0.9000	37.1712
North East	7.0800	106.0502	0.4600	0.0000	0.9000	310.8459
South East	6.5000	127.3119	0.4600	0.0000	0.9000	342.5962
South West	1.5000	127.3119	0.4600	0.0000	0.9000	79.0607
West	1.0300	125.2818	0.4600	0.0000	0.9000	53.4227
South West	6.6600	127.3119	0.4600	0.0000	0.9000	351.0293
total:						1174.1260

	Jun	Jul	Aug	
Solar gains	1260	1174	1051	(P4)
Internal gains	574	552	561	
Total summer gains	1835	1726	1612	(P5)
Summer gain/loss ratio	3.58	3.37	3.15	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 150.0)	0.95	0.95	0.95	
Threshold temperature	19.93	21.62	21.40	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight