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

AES Sustainability Consultants

Property Reference	X413 Det (ASHP)	**Issued on Date**	15/12/2022
Assessment Reference	X413 Det (ASHP)	**Prop Type Ref**	Chestnut
Property	4 Bed, K, WC, B, En		

SAP Rating	87 B	**DER**	13.18	**TER**	24.90
Environmental	88 B	**% DER<TER**	47.07		
CO_2 Emissions (t/year)	1.45	**DFEE**	45.63	**TFEE**	58.50
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.99		

Assessor Details	Mr. Christopher MacDougall, Chris MacDougall, Tel: 02032 902 902, chris.macdougall@aessc.co.uk	**Assessor ID**	Q920-0001
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 DESIGNED

Detached House, total floor area 127 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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 24.90 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.18 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)58.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.6 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	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	OK
Openings	1.26 (max. 2.00)	1.40 (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: 4.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Vaillant aroTHERM 8kW VWL 85/3 A 230v

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.56 kWh/day
Permitted by DBSCG 2.24 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW 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
Continuous extract system (decentralised)
Specific fan power: 0.1700 0.1800
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 17.15 m², No overhang
Windows facing East: 2.31 m², No overhang
Windows facing South: 10.85 m², No overhang
Windows facing West: 1.53 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
Roof U-value 0.09 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Thermal bridging y-value 0.021 W/m²K

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	327.2825	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(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) =	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.6105	54.0691	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	147.1720	146.6306	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.6195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1579	1.1537	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1536	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Daily hot water use
                113.0443   108.9336   104.8229   100.7122    96.6015    92.4908    92.4908    96.6015   100.7122   104.8229   108.9336   113.0443 (44)
Energy conte    167.6415   146.6203   151.2990   131.9062   126.5671   109.2178   101.2063   116.1358   117.5228   136.9615   149.5042   162.3518 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1616.9343 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 25.1462    21.9930    22.6949    19.7859    18.9851    16.3827    15.1810    17.4204    17.6284    20.5442    22.4256    24.3528 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                   1.5600 (48)
  Temperature factor from Table 2b                                                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                       0.8424 (55)
Total storage loss
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (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
                217.0183   191.2187   200.6758   179.6902   175.9439   157.0018   150.5831   165.5126   165.3068   186.3383   197.2882   211.7286 (62)
WWHRS           -59.9595   -52.7585   -53.8459   -44.2906   -41.1183   -33.9161   -28.6962   -34.7472   -35.7645   -44.2208   -51.2358   -57.9563 eq.(G10)
Total of WWHRS savings                                                                                                                      -538.5096
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
                157.0588   138.4602   146.8299   135.3996   134.8256   123.0857   121.8869   130.7654   129.5423   142.1175   146.0524   153.7723 (64)
                                                                                                     Total per year (kWh/year) = Sum(64)m =   1659.7967 (64)
Heat gains from water heating, kWh/month
                 95.2422    84.4300    89.8084    82.0860    81.5850    74.5421    73.1525    78.1166    77.3035    85.0411    87.9373    93.4834 (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           144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528   144.3528 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 26.2273    23.2948    18.9446    14.3423    10.7210     9.0512     9.7801    12.7125    17.0627    21.6651    25.2863    26.9562 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                294.1903   297.2430   289.5501   273.1729   252.4995   233.0695   220.0891   217.0363   224.7292   241.1064   261.7798   281.2098 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353    37.4353 (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)
               -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823 (71)
Water heating gains (Table 5)
                128.0138   125.6398   120.7102   114.0083   109.6573   103.5307    98.3233   104.9954   107.3660   114.3026   122.1352   125.6498 (72)
Total internal gains
                514.7371   512.4836   495.5108   467.8294   439.1837   411.9572   394.4983   401.0501   415.4638   443.3799   475.5071   500.1216 (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                                     4.9200          10.6334          0.4600           0.0000          0.7700          18.5304 (74)
East                                      2.3100          19.6403          0.4600           0.0000          0.7700          16.0697 (76)
South                                    10.8500          46.7521          0.4600           0.0000          0.7700         179.6715 (78)
West                                      1.5300          19.6403          0.4600           0.0000          0.7700          10.6436 (80)
North                                    12.2300          10.6334          0.4300           0.0000          0.7700          43.0584 (74)
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Solar gains     267.9735   464.2117   660.8888   870.4025  1028.0329  1045.5823   997.5363   875.0441   732.1091   519.4950   322.2580   228.5638 (83)
Total gains     782.7107   976.6953  1156.3996  1338.2318  1467.2166  1457.5396  1392.0346  1276.0942  1147.5728   962.8750   797.7651   728.6855 (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             34.2135    34.3399    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557
alpha            3.2809     3.2893     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904
util living area
                 0.9839     0.9671     0.9336     0.8614     0.7379     0.5802     0.4427     0.4957     0.7163     0.9056     0.9717     0.9871 (86)

Tweekday        17.4420    17.8790    18.4713    19.1323    19.6301    19.8743    19.9405    19.9305    19.7663    19.1008    18.1328    17.3510
Tweekend        19.7820    19.9767    20.2444    20.5515    20.7974    20.9333    20.9794    20.9699    20.8632    20.5286    20.0880    19.7405
24 / 16               0          0          0          0          0          0          0          0          0          0          0          0
24 / 9                0          0          0          0          0          0          0          0          0          0          0          0
16 / 9                0          0          0          0          0          0          0          0          0          0          0          0
MIT             19.1203    19.4171    19.8339    20.2997    20.6873    20.8975    20.9681    20.9535    20.7865    20.2725    19.5759    19.0561 (87)
Th 2            19.9538    19.9572    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577 (88)
util rest of house
                 0.9807     0.9607     0.9206     0.8343     0.6885     0.5038     0.3460     0.3956     0.6463     0.8808     0.9650     0.9845 (89)
Tweekday        17.4420    17.8790    18.4713    19.1323    19.6301    19.8743    19.9405    19.9305    19.7663    19.1008    18.1328    17.3510
Tweekend        17.4420    17.8790    18.4713    19.1323    19.6301    19.8743    19.9405    19.9305    19.7663    19.1008    18.1328    17.3510
MIT 2           17.4420    17.8790    18.4713    19.1323    19.6301    19.8743    19.9405    19.9305    19.7663    19.1008    18.1328    17.3510 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.1334 (91)
MIT             17.6659    18.0842    18.6531    19.2881    19.7712    20.0109    20.0776    20.0670    19.9024    19.2572    18.3254    17.5785 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT    17.6659    18.0842    18.6531    19.2881    19.7712    20.0109    20.0776    20.0670    19.9024    19.2572    18.3254    17.5785 (93)


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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9701	0.9447	0.8996	0.8138	0.6787	0.5080	0.3575	0.4066	0.6421	0.8598	0.9502	0.9755	(94)
Useful gains	759.3405	922.6587	1040.2890	1088.9862	995.8309	740.3636	497.6803	518.9185	736.8863	827.9050	758.0145	710.7998	(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	1967.0899	1933.2111	1781.1969	1522.5129	1182.9344	793.0322	509.6869	537.4529	850.4241	1268.8225	1645.2277	1960.8013	(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	898.5655	679.0912	551.2355	312.1392	139.2051	0.0000	0.0000	0.0000	0.0000	328.0426	638.7935	930.0011	(98)

Space heating 4477.0737 (98)
Space heating per m2 (98) / (4) = 35.2248 (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 %)	263.7800	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1697.2757	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	898.5655	679.0912	551.2355	312.1392	139.2051	0.0000	0.0000	0.0000	0.0000	328.0426	638.7935	930.0011	(98)
Space heating efficiency (main heating system 1)	263.7800	263.7800	263.7800	263.7800	263.7800	0.0000	0.0000	0.0000	0.0000	263.7800	263.7800	263.7800	(210)
Space heating fuel (main heating system)	340.6496	257.4461	208.9755	118.3332	52.7732	0.0000	0.0000	0.0000	0.0000	124.3622	242.1690	352.5670	(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	157.0588	138.4602	146.8299	135.3996	134.8256	123.0857	121.8869	130.7654	129.5423	142.1175	146.0524	153.7723	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	92.2356	81.3133	86.2285	79.5159	79.1788	72.2843	71.5803	76.7943	76.0760	83.4611	85.7719	90.3056	(219)

Water heating fuel used	974.7455	(219)
Annual totals kWh/year		
Space heating fuel - main system	1697.2757	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)

mechanical ventilation fans (SFP = 0.2294)	91.6088	(230a)
Total electricity for the above, kWh/year	91.6088	(231)
Electricity for lighting (calculated in Appendix L)	463.1819	(232)
Total delivered energy for all uses	3226.8120	(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	1697.2757	0.5190	880.8861	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	974.7455	0.5190	505.8929	(264)
Space and water heating			1386.7790	(265)
Pumps and fans	91.6088	0.5190	47.5450	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)
Total CO2, kg/year			1674.7154	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.1800	(273)

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

DER		13.1800	ZC1
Total Floor Area	TFA	127.1000	
Assumed number of occupants	N	2.8871	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.7160	ZC2
CO2 emissions from cooking, equation (L16)		1.4814	ZC3
Total CO2 emissions		28.3775	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		28.3775	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		327.2825	(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) =	0.1222	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3722	(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) =	0.3722	(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	0.4746	0.4653	0.4560	0.4094	0.4001	0.3536	0.3536	0.3443	0.3722	0.4001	0.4187	0.4374	(22b)
Effective ac	0.6126	0.6082	0.6040	0.5838	0.5801	0.5625	0.5625	0.5593	0.5693	0.5801	0.5877	0.5956	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			29.6300	1.3258	39.2822			(27)
FP McCann System			63.5500	0.1300	8.2615			(28a)
100mm Knauf Supafil 34	166.0400	31.7800	134.2600	0.1800	24.1668			(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.1300	8.2615			(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.1220			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.9667	(36)
Total fabric heat loss					(33) + (36) =		95.0887	(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	66.1641	65.6918	65.2289	63.0545	62.6477	60.7539	60.7539	60.4032	61.4834	62.6477	63.4707	64.3311	(38)
Heat transfer coeff	161.2528	160.7805	160.3176	158.1432	157.7364	155.8426	155.8426	155.4919	156.5721	157.7364	158.5594	159.4198	(39)
Average = Sum(39)m / 12 =												158.1413	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2687	1.2650	1.2614	1.2442	1.2410	1.2261	1.2261	1.2234	1.2319	1.2410	1.2475	1.2543	(40)
HLP (average)												1.2442	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.0443	108.9336	104.8229	100.7122	96.6015	92.4908	92.4908	96.6015	100.7122	104.8229	108.9336	113.0443	(44)
Energy conte	167.6415	146.6203	151.2990	131.9062	126.5671	109.2178	101.2063	116.1358	117.5228	136.9615	149.5042	162.3518	(45)
Energy content (annual)										Total = Sum(45)m =		1616.9343	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1462	21.9930	22.6949	19.7859	18.9851	16.3827	15.1810	17.4204	17.6284	20.5442	22.4256	24.3528	(46)

Water storage loss:		
Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6525	(48)
Temperature factor from Table 2b	0.5400	(49)

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Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	218.5676	192.6181	202.2251	181.1895	177.4932	158.5011	152.1324	167.0618	166.8061	187.8876	198.7875	213.2779	(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	218.5676	192.6181	202.2251	181.1895	177.4932	158.5011	152.1324	167.0618	166.8061	187.8876	198.7875	213.2779	(64)
Total per year (kWh/year) = Sum(64)m =												2216.5478	(64)
Heat gains from water heating, kWh/month	96.4817	85.5495	91.0478	83.2854	82.8244	75.7416	74.3920	79.3560	78.5030	86.2806	89.1368	94.7228	(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	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2273	23.2948	18.9446	14.3423	10.7210	9.0512	9.7801	12.7125	17.0627	21.6651	25.2863	26.9562	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	294.1903	297.2430	289.5501	273.1729	252.4995	233.0695	220.0891	217.0363	224.7292	241.1064	261.7798	281.2098	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	(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)	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	(71)
Water heating gains (Table 5)	129.6796	127.3057	122.3761	115.6742	111.3232	105.1966	99.9892	106.6613	109.0319	115.9685	123.8011	127.3157	(72)
Total internal gains	519.4030	517.1495	500.1767	472.4953	443.8496	416.6231	399.1642	405.7159	420.1297	448.0458	480.1730	504.7875	(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	15.9600	10.6334	0.6300	0.7000	0.7700	51.8653	(74)
East	2.1500	19.6403	0.6300	0.7000	0.7700	12.9050	(76)
South	10.1000	46.7521	0.6300	0.7000	0.7700	144.3092	(78)
West	1.4200	19.6403	0.6300	0.7000	0.7700	8.5233	(80)

Solar gains	217.6027	377.3767	538.5145	711.4733	842.3922	857.6724	817.8930	716.0510	597.2787	422.6418	261.7566	185.5554	(83)
Total gains	737.0058	894.5262	1038.6912	1183.9686	1286.2418	1274.2955	1217.0572	1121.7669	1017.4084	870.6876	741.9297	690.3430	(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	54.7363	54.8971	55.0556	55.8126	55.9566	56.6366	56.6366	56.7643	56.3727	55.9566	55.6661	55.3657	
alpha	4.6491	4.6598	4.6704	4.7208	4.7304	4.7758	4.7758	4.7843	4.7582	4.7304	4.7111	4.6910	
util living area	0.9982	0.9954	0.9870	0.9578	0.8750	0.7130	0.5469	0.6086	0.8502	0.9759	0.9961	0.9987	(86)
MIT	19.5844	19.7709	20.0589	20.4337	20.7518	20.9353	20.9854	20.9763	20.8432	20.4252	19.9364	19.5578	(87)
Th 2	19.8654	19.8684	19.8712	19.8848	19.8873	19.8991	19.8991	19.9013	19.8946	19.8873	19.8822	19.8768	(88)
util rest of house	0.9976	0.9937	0.9822	0.9413	0.8272	0.6168	0.4184	0.4773	0.7759	0.9635	0.9944	0.9983	(89)
MIT 2	17.9854	18.2595	18.6796	19.2223	19.6451	19.8566	19.8939	19.8918	19.7689	19.2209	18.5116	17.9544	(90)
Living area fraction									fLA = Living area / (4) =			0.1334	(91)
MIT	18.1988	18.4612	18.8636	19.3839	19.7928	20.0005	20.0396	20.0365	19.9122	19.3816	18.7017	18.1684	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1988	18.4612	18.8636	19.3839	19.7928	20.0005	20.0396	20.0365	19.9122	19.3816	18.7017	18.1684	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9907	0.9761	0.9317	0.8223	0.6264	0.4355	0.4945	0.7773	0.9556	0.9917	0.9972	(94)
Useful gains	734.1904	886.1700	1013.8807	1103.1388	1057.7390	798.2657	530.0049	554.6613	790.8208	832.0198	735.7534	688.3819	(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	2241.2150	2180.3779	1982.1102	1657.9610	1276.5243	841.6304	536.0322	565.4450	910.0326	1385.1736	1839.5559	2226.8346	(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	1121.2263	869.7077	720.3628	399.4720	162.7763	0.0000	0.0000	0.0000	0.0000	411.5464	794.7379	1144.6088	(98)
Space heating												5624.4381	(98)
Space heating per m2											(98) / (4) =	44.2521	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6015.4418	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1121.2263	869.7077	720.3628	399.4720	162.7763	0.0000	0.0000	0.0000	0.0000	411.5464	794.7379	1144.6088	(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)	1199.1725	930.1687	770.4415	427.2428	174.0923	0.0000	0.0000	0.0000	0.0000	440.1566	849.9870	1224.1805	(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	218.5676	192.6181	202.2251	181.1895	177.4932	158.5011	152.1324	167.0618	166.8061	187.8876	198.7875	213.2779	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5628	88.3520	87.9161	86.8656	84.5840	79.8000	79.8000	79.8000	79.8000	86.8499	88.1355	88.6334	(217)
Fuel for water heating, kWh/month	246.7940	218.0122	230.0206	208.5861	209.8425	198.6229	190.6421	209.3507	209.0302	216.3360	225.5476	240.6294	(219)
Water heating fuel used												2603.4142	(219)

Annual totals kWh/year		
Space heating fuel - main system	6015.4418	(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)	463.1819	(232)
Total delivered energy for all uses	9157.0379	(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	6015.4418	0.2160	1299.3354	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2603.4142	0.2160	562.3375	(264)
Space and water heating			1861.6729	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)
Total CO2, kg/m2/year			2140.9893	(272)
Emissions per m2 for space and water heating			14.6473	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.8914	(272b)
Emissions per m2 for pumps and fans			0.3063	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6473 * 1.55) + 1.8914 + 0.3063, rounded to 2 d.p.			24.9000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 127.1000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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) =		0.1222	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.3227	(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)	=	0.3227	(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	0.4115	0.4034	0.3953	0.3550	0.3469	0.3066	0.3066	0.2985	0.3227	0.3469	0.3631	0.3792	(22b)
Effective ac	0.5847	0.5814	0.5781	0.5630	0.5602	0.5470	0.5470	0.5446	0.5521	0.5602	0.5659	0.5719	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	63.1443	62.7893	62.4413	60.8068	60.5010	59.0774	59.0774	58.8138	59.6257	60.5010	61.1196	61.7664	(38)
Heat transfer coeff	155.7058	155.3508	155.0028	153.3683	153.0625	151.6389	151.6389	151.3752	152.1872	153.0625	153.6811	154.3279	(39)
Average = Sum(39)m / 12 =												153.3668	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2251	1.2223	1.2195	1.2067	1.2043	1.1931	1.1931	1.1910	1.1974	1.2043	1.2091	1.2142	(40)
HLP (average)												1.2067	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.0443	108.9336	104.8229	100.7122	96.6015	92.4908	92.4908	96.6015	100.7122	104.8229	108.9336	113.0443	(44)
Energy conte	167.6415	146.6203	151.2990	131.9062	126.5671	109.2178	101.2063	116.1358	117.5228	136.9615	149.5042	162.3518	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1616.9343	(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													
	35.6238	31.1568	32.1510	28.0301	26.8955	23.2088	21.5063	24.6788	24.9736	29.1043	31.7696	34.4998	(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	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.2273	23.2948	18.9446	14.3423	10.7210	9.0512	9.7801	12.7125	17.0627	21.6651	25.2863	26.9562	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	294.1903	297.2430	289.5501	273.1729	252.4995	233.0695	220.0891	217.0363	224.7292	241.1064	261.7798	281.2098	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	(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)													
	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	(71)
Water heating gains (Table 5)													
	47.8815	46.3643	43.2138	38.9306	36.1499	32.2344	28.9064	33.1705	34.6855	39.1187	44.1245	46.3707	(72)
Total internal gains													
	434.6049	433.2080	418.0144	392.7517	365.6763	340.6609	325.0814	329.2252	342.7833	368.1960	397.4964	420.8425	(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	4.9200	10.6334	0.4600	0.0000	0.7700	18.5304	(74)
East	2.3100	19.6403	0.4600	0.0000	0.7700	16.0697	(76)
South	10.8500	46.7521	0.4600	0.0000	0.7700	179.6715	(78)
West	1.5300	19.6403	0.4600	0.0000	0.7700	10.6436	(80)
North	12.2300	10.6334	0.4300	0.0000	0.7700	43.0584	(74)

Solar gains	267.9735	464.2117	660.8888	870.4025	1028.0329	1045.5823	997.5363	875.0441	732.1091	519.4950	322.2580	228.5638	(83)
Total gains	702.5784	897.4197	1078.9032	1263.1541	1393.7092	1386.2433	1322.6177	1204.2693	1074.8924	887.6911	719.7544	649.4064	(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	32.3384	32.4123	32.4851	32.8313	32.8969	33.2057	33.2057	33.2635	33.0861	32.8969	32.7644	32.6271	
alpha	3.1559	3.1608	3.1657	3.1888	3.1931	3.2137	3.2137	3.2176	3.2057	3.1931	3.1843	3.1751	
util living area													
	0.9882	0.9745	0.9466	0.8830	0.7695	0.6142	0.4751	0.5318	0.7533	0.9250	0.9790	0.9907	(86)
MIT	18.9108	19.2157	19.6538	20.1844	20.6131	20.8684	20.9571	20.9381	20.7345	20.1504	19.4241	18.8570	(87)
Th 2	19.9000	19.9022	19.9044	19.9147	19.9166	19.9256	19.9256	19.9272	19.9221	19.9166	19.9127	19.9086	(88)
util rest of house													
	0.9857	0.9693	0.9354	0.8582	0.7210	0.5348	0.3704	0.4247	0.6842	0.9037	0.9739	0.9888	(89)
MIT 2	17.9966	18.2999	18.7314	19.2479	19.6380	19.8524	19.9097	19.9024	19.7557	19.2290	18.5167	17.9494	(90)
Living area fraction										fLA = Living area / (4) =		0.1334	(91)
MIT	18.1186	18.4221	18.8545	19.3729	19.7681	19.9880	20.0495	20.0406	19.8863	19.3519	18.6378	18.0705	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1186	18.4221	18.8545	19.3729	19.7681	19.9880	20.0495	20.0406	19.8863	19.3519	18.6378	18.0705	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9599	0.9218	0.8435	0.7136	0.5398	0.3831	0.4368	0.6816	0.8897	0.9656	0.9841	(94)
Useful gains	688.6090	861.4190	994.5761	1065.5146	994.5712	748.2673	506.7035	526.0041	732.6181	789.7725	694.9634	639.0854	(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													
	2151.6414	2100.6674	1914.9847	1606.2087	1234.9268	817.0243	523.0740	551.0971	880.6075	1339.5902	1773.1370	2140.6129	(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													
	1088.4961	832.7749	684.7840	389.2997	178.8246	0.0000	0.0000	0.0000	0.0000	409.0644	776.2850	1117.1365	(98)
Space heating												5476.6652	(98)
Space heating per m2											(98) / (4) =	43.0894	(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	1425.4054	1122.1277	1150.4519	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8320	0.8862	0.8573	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1185.9872	994.4064	986.2910	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1737.7870	1660.7498	1524.6159	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	397.2959	495.7595	400.5137	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1293.5690	(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	99.3240	123.9399	100.1284	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												323.3923	(107)
Space cooling per m2												2.5444	(108)
Energy for space heating												43.0894	(99)
Energy for space cooling												2.5444	(108)
Total												45.6338	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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) =		0.1222	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3722	(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) =		0.3722	(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	0.4746	0.4653	0.4560	0.4094	0.4001	0.3536	0.3536	0.3443	0.3722	0.4001	0.4187	0.4374	(22b)
Effective ac	0.6126	0.6082	0.6040	0.5838	0.5801	0.5625	0.5625	0.5593	0.5693	0.5801	0.5877	0.5956	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			29.6300	1.3258	39.2822			(27)
FP McCann System			63.5500	0.1300	8.2615			(28a)
100mm Knauf Supafil 34	166.0400	31.7800	134.2600	0.1800	24.1668			(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.1300	8.2615			(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	82.1220			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.9667	(36)
Total fabric heat loss					(33) + (36) =		95.0887	(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	66.1641	65.6918	65.2289	63.0545	62.6477	60.7539	60.7539	60.4032	61.4834	62.6477	63.4707	64.3311	(38)
Heat transfer coeff	161.2528	160.7805	160.3176	158.1432	157.7364	155.8426	155.8426	155.4919	156.5721	157.7364	158.5594	159.4198	(39)
Average = Sum(39)m / 12 =												158.1413	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2687	1.2650	1.2614	1.2442	1.2410	1.2261	1.2261	1.2234	1.2319	1.2410	1.2475	1.2543	(40)
HLP (average)												1.2442	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.0443	108.9336	104.8229	100.7122	96.6015	92.4908	92.4908	96.6015	100.7122	104.8229	108.9336	113.0443	(44)
Energy conte	167.6415	146.6203	151.2990	131.9062	126.5671	109.2178	101.2063	116.1358	117.5228	136.9615	149.5042	162.3518	(45)
Energy content (annual)										Total = Sum(45)m =		1616.9343	(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													
	35.6238	31.1568	32.1510	28.0301	26.8955	23.2088	21.5063	24.6788	24.9736	29.1043	31.7696	34.4998	(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	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	144.3528	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.2273	23.2948	18.9446	14.3423	10.7210	9.0512	9.7801	12.7125	17.0627	21.6651	25.2863	26.9562	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	294.1903	297.2430	289.5501	273.1729	252.4995	233.0695	220.0891	217.0363	224.7292	241.1064	261.7798	281.2098	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	37.4353	(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)													
	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	(71)
Water heating gains (Table 5)													
	47.8815	46.3643	43.2138	38.9306	36.1499	32.2344	28.9064	33.1705	34.6855	39.1187	44.1245	46.3707	(72)
Total internal gains													
	434.6049	433.2080	418.0144	392.7517	365.6763	340.6609	325.0814	329.2252	342.7833	368.1960	397.4964	420.8425	(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	15.9600	10.6334	0.6300	0.7000	0.7700	51.8653	(74)
East	2.1500	19.6403	0.6300	0.7000	0.7700	12.9050	(76)
South	10.1000	46.7521	0.6300	0.7000	0.7700	144.3092	(78)
West	1.4200	19.6403	0.6300	0.7000	0.7700	8.5233	(80)

Solar gains	217.6027	377.3767	538.5145	711.4733	842.3922	857.6724	817.8930	716.0510	597.2787	422.6418	261.7566	185.5554	(83)
Total gains	652.2076	810.5847	956.5289	1104.2250	1208.0685	1198.3333	1142.9744	1045.2762	940.0620	790.8379	659.2531	606.3980	(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	54.7363	54.8971	55.0556	55.8126	55.9566	56.6366	56.6366	56.7643	56.3727	55.9566	55.6661	55.3657	
alpha	4.6491	4.6598	4.6704	4.7208	4.7304	4.7758	4.7758	4.7843	4.7582	4.7304	4.7111	4.6910	
util living area													
	0.9990	0.9969	0.9906	0.9670	0.8951	0.7434	0.5779	0.6447	0.8784	0.9833	0.9976	0.9993	(86)
MIT	19.5235	19.7114	20.0027	20.3856	20.7197	20.9224	20.9816	20.9698	20.8147	20.3729	19.8774	19.4973	(87)
Th 2	19.8654	19.8684	19.8712	19.8848	19.8873	19.8991	19.8991	19.9013	19.8946	19.8873	19.8822	19.8768	(88)
util rest of house													
	0.9986	0.9958	0.9871	0.9536	0.8518	0.6482	0.4443	0.5096	0.8113	0.9743	0.9966	0.9990	(89)
MIT 2	18.5211	18.7108	19.0025	19.3878	19.6966	19.8634	19.8946	19.8927	19.7893	19.3826	18.8877	18.5038	(90)
Living area fraction									fLA = Living area / (4) =			0.1334	(91)
MIT	18.6548	18.8443	19.1360	19.5209	19.8331	20.0047	20.0396	20.0365	19.9262	19.5147	19.0198	18.6364	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6548	18.8443	19.1360	19.5209	19.8331	20.0047	20.0396	20.0365	19.9262	19.5147	19.0198	18.6364	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9944	0.9839	0.9480	0.8493	0.6583	0.4622	0.5274	0.8137	0.9701	0.9954	0.9986	(94)
Useful gains	650.9091	806.0511	941.1350	1046.7851	1026.0579	788.8408	528.2872	551.3101	764.9093	767.2259	656.2405	605.5411	(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													
	2314.7600	2241.9703	2025.7745	1679.6267	1282.8918	842.2787	536.0379	565.4420	912.2129	1406.1750	1889.9936	2301.4485	(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													
	1237.9051	964.9377	806.9718	455.6460	191.0844	0.0000	0.0000	0.0000	0.0000	475.3781	888.3022	1261.7551	(98)
Space heating												6281.9804	(98)
Space heating per m2											(98) / (4) =	49.4255	(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	1464.9203	1153.2351	1181.7383	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8413	0.9067	0.8744	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1232.4095	1045.6183	1033.3010	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1518.1520	1450.7771	1338.7798	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	205.7346	301.4382	227.2763	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												734.4490	(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	51.4336	75.3595	56.8191	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												183.6122	(107)
Space cooling per m2												1.4446	(108)
Energy for space heating												49.4255	(99)
Energy for space cooling												1.4446	(108)
Total												50.8701	(109)
Target Fabric Energy Efficiency (TFEE)												58.5	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 127.1000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(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) =	0.2005	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.5631	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1531	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use													
	113.0443	108.9336	104.8229	100.7122	96.6015	92.4908	92.4908	96.6015	100.7122	104.8229	108.9336	113.0443	(44)
Energy conte	167.6415	146.6203	151.2990	131.9062	126.5671	109.2178	101.2063	116.1358	117.5228	136.9615	149.5042	162.3518	(45)
Energy content (annual)										Total = Sum(45)m =		1616.9343	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.1462	21.9930	22.6949	19.7859	18.9851	16.3827	15.1810	17.4204	17.6284	20.5442	22.4256	24.3528	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8424	(55)
Total storage loss													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(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													
	217.0183	191.2187	200.6758	179.6902	175.9439	157.0018	150.5831	165.5126	165.3068	186.3383	197.2882	211.7286	(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													
	217.0183	191.2187	200.6758	179.6902	175.9439	157.0018	150.5831	165.5126	165.3068	186.3383	197.2882	211.7286	(64)
								Total per year (kWh/year) = Sum(64)m =				2198.3063	(64)
RHI water heating demand												2198	(64)
Heat gains from water heating, kWh/month													
	95.2422	84.4300	89.8084	82.0860	81.5850	74.5421	73.1525	78.1166	77.3035	85.0411	87.9373	93.4834	(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	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.5682	58.2371	47.3616	35.8558	26.8026	22.6279	24.4502	31.7813	42.6568	54.1627	63.2158	67.3905	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	439.0899	443.6463	432.1644	407.7207	376.8650	347.8649	328.4911	323.9347	335.4167	359.8603	390.7161	419.7161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	(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)													
	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	(71)
Water heating gains (Table 5)													
	128.0138	125.6398	120.7102	114.0083	109.6573	103.5307	98.3233	104.9954	107.3660	114.3026	122.1352	125.6498	(72)
Total internal gains													
	745.6224	740.4738	713.1867	670.5354	626.2754	586.9741	564.2152	573.6620	598.3900	641.2761	689.0176	725.7070	(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	4.9200	11.9814	0.4600	0.0000	0.7700	20.8796	(74)
East	2.3100	22.3313	0.4600	0.0000	0.7700	18.2715	(76)
South	10.8500	50.9848	0.4600	0.0000	0.7700	195.9382	(78)
West	1.5300	22.3313	0.4600	0.0000	0.7700	12.1019	(80)
North	12.2300	11.9814	0.4300	0.0000	0.7700	48.5171	(74)

Solar gains	295.7084	461.8301	652.7427	892.3490	1032.0608	1125.3730	1061.2661	948.3920	785.9961	552.6784	364.4663	249.7076	(83)
Total gains	1041.3308	1202.3039	1365.9293	1562.8844	1658.3361	1712.3470	1625.4813	1522.0540	1384.3861	1193.9545	1053.4839	975.4146	(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	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	
alpha	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	
util living area													
	0.9597	0.9369	0.8869	0.7821	0.6215	0.4126	0.2765	0.3037	0.5597	0.8185	0.9309	0.9661	(86)
Tweekday	18.0154	18.3338	18.8812	19.4480	19.8095	19.9397	19.9561	19.9553	19.8950	19.4704	18.6679	17.9246	
Tweekend	20.0381	20.1830	20.4350	20.7076	20.8975	20.9809	20.9964	20.9951	20.9457	20.7107	20.3318	19.9969	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.5155	19.7362	20.1280	20.5435	20.8418	20.9707	20.9945	20.9924	20.9151	20.5534	19.9567	19.4519	(87)
Th 2	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	(88)
util rest of house													
	0.9519	0.9253	0.8661	0.7440	0.5603	0.3323	0.1849	0.2068	0.4761	0.7766	0.9158	0.9594	(89)
Tweekday	18.0154	18.3338	18.8812	19.4480	19.8095	19.9397	19.9561	19.9553	19.8950	19.4704	18.6679	17.9246	
Tweekend	18.0154	18.3338	18.8812	19.4480	19.8095	19.9397	19.9561	19.9553	19.8950	19.4704	18.6679	17.9246	
MIT 2	18.0154	18.3338	18.8812	19.4480	19.8095	19.9397	19.9561	19.9553	19.8950	19.4704	18.6679	17.9246	(90)
Living area fraction									fLA = Living area / (4) =			0.1334	(91)
MIT	18.2155	18.5209	19.0476	19.5942	19.9472	20.0773	20.0947	20.0937	20.0312	19.6149	18.8398	18.1284	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2155	18.5209	19.0476	19.5942	19.9472	20.0773	20.0947	20.0937	20.0312	19.6149	18.8398	18.1284	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9343	0.9045	0.8442	0.7291	0.5597	0.3418	0.1971	0.2197	0.4823	0.7606	0.8948	0.9432	(94)
Useful gains	972.9029	1087.5018	1153.0718	1139.5645	928.1368	585.2618	320.4059	334.3532	667.7006	908.1729	942.6132	919.9775	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1922.2542	1893.7303	1707.1078	1420.8130	1018.2075	597.5759	321.6561	336.1762	708.0700	1174.6850	1588.7209	1909.4841	(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	706.3174	541.7856	412.2027	202.4989	67.0126	0.0000	0.0000	0.0000	0.0000	198.2850	465.1976	736.1929	(98)
Space heating												3329.4927	(98)
RHI space heating demand												3329	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 127.1000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(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) =	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.6105	54.0691	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	147.1720	146.6306	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.6195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1579	1.1537	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1536	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Daily hot water use
                113.0443   108.9336   104.8229   100.7122    96.6015    92.4908    92.4908    96.6015   100.7122   104.8229   108.9336   113.0443 (44)
Energy conte    167.6415   146.6203   151.2990   131.9062   126.5671   109.2178   101.2063   116.1358   117.5228   136.9615   149.5042   162.3518 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1616.9343 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 25.1462    21.9930    22.6949    19.7859    18.9851    16.3827    15.1810    17.4204    17.6284    20.5442    22.4256    24.3528 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                   1.5600 (48)
  Temperature factor from Table 2b                                                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                       0.8424 (55)
Total storage loss
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (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
                217.0183   191.2187   200.6758   179.6902   175.9439   157.0018   150.5831   165.5126   165.3068   186.3383   197.2882   211.7286 (62)
WWHRS           -59.9595   -52.7585   -53.8459   -44.2906   -41.1183   -33.9161   -28.6962   -34.7472   -35.7645   -44.2208   -51.2358   -57.9563 eq.(G10)
Total of WWHRS savings                                                                                                                      -538.5096
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
                157.0588   138.4602   146.8299   135.3996   134.8256   123.0857   121.8869   130.7654   129.5423   142.1175   146.0524   153.7723 (64)
                                                                                                     Total per year (kWh/year) = Sum(64)m =   1659.7967 (64)
Heat gains from water heating, kWh/month
                 95.2422    84.4300    89.8084    82.0860    81.5850    74.5421    73.1525    78.1166    77.3035    85.0411    87.9373    93.4834 (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           173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 65.5682    58.2371    47.3616    35.8558    26.8026    22.6279    24.4502    31.7813    42.6568    54.1627    63.2158    67.3905 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                439.0899   443.6463   432.1644   407.7207   376.8650   347.8649   328.4911   323.9347   335.4167   359.8603   390.7161   419.7161 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094 (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)
               -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823 (71)
Water heating gains (Table 5)
                128.0138   125.6398   120.7102   114.0083   109.6573   103.5307    98.3233   104.9954   107.3660   114.3026   122.1352   125.6498 (72)
Total internal gains
                745.6224   740.4738   713.1867   670.5354   626.2754   586.9741   564.2152   573.6620   598.3900   641.2761   689.0176   725.7070 (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                                      4.9200          10.6334          0.4600           0.0000          0.7700          18.5304 (74)
East                                       2.3100          19.6403          0.4600           0.0000          0.7700          16.0697 (76)
South                                     10.8500          46.7521          0.4600           0.0000          0.7700         179.6715 (78)
West                                       1.5300          19.6403          0.4600           0.0000          0.7700          10.6436 (80)
North                                     12.2300          10.6334          0.4300           0.0000          0.7700          43.0584 (74)
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Solar gains    267.9735   464.2117   660.8888   870.4025  1028.0329  1045.5823   997.5363   875.0441   732.1091   519.4950   322.2580   228.5638 (83)
Total gains   1013.5959  1204.6855  1374.0755  1540.9378  1654.3082  1632.5564  1561.7515  1448.7061  1330.4991  1160.7711  1011.2756   954.2708 (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             34.2135    34.3399    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557
alpha            3.2809     3.2893     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904
util living area
                 0.9671     0.9433     0.9005     0.8176     0.6880     0.5311     0.3994     0.4445     0.6532     0.8588     0.9471     0.9725 (86)

Tweekday        17.7795    18.1831    18.7144    19.2870    19.7001    19.8949    19.9452    19.9385    19.8185    19.2827    18.4217    17.6877
Tweekend        19.9337    20.1153    20.3584    20.6289    20.8375    20.9487    20.9848    20.9782    20.8972    20.6189    20.2200    19.8913
24 / 16             0          0          0          0          0          0          0          0          0          0          0          0
24 / 9              0          0          0          0          0          0          0          0          0          0          0          0
16 / 9              0          0          0          0          0          0          0          0          0          0          0          0
MIT             19.3543    19.6315    20.0098    20.4206    20.7492    20.9212    20.9765    20.9663    20.8395    20.4118    19.7820    19.2888 (87)
Th 2            19.9538    19.9572    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577 (88)
util rest of house
                 0.9610     0.9331     0.8828     0.7859     0.6365     0.4575     0.3102     0.3518     0.5814     0.8264     0.9358     0.9672 (89)
Tweekday        17.7795    18.1831    18.7144    19.2870    19.7001    19.8949    19.9452    19.9385    19.8185    19.2827    18.4217    17.6877
Tweekend        17.7795    18.1831    18.7144    19.2870    19.7001    19.8949    19.9452    19.9385    19.8185    19.2827    18.4217    17.6877
MIT 2           17.7795    18.1831    18.7144    19.2870    19.7001    19.8949    19.9452    19.9385    19.8185    19.2827    18.4217    17.6877 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.1334 (91)
MIT             17.9897    18.3764    18.8873    19.4382    19.8401    20.0319    20.0828    20.0756    19.9547    19.4334    18.6032    17.9013 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT    17.9897    18.3764    18.8873    19.4382    19.8401    20.0319    20.0828    20.0756    19.9547    19.4334    18.6032    17.9013 (93)


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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9129	0.8606	0.7678	0.6302	0.4630	0.3213	0.3627	0.5811	0.8069	0.9162	0.9527	(94)
Useful gains	957.7694	1099.7906	1182.5105	1183.1458	1042.5471	755.8674	501.7137	525.4687	773.1985	936.6340	926.5286	909.1156	(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	2014.7344	1976.0465	1815.5178	1544.5158	1193.0382	796.1113	510.4573	538.7143	858.0855	1294.6496	1685.9520	2008.1070	(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	786.3819	588.8440	470.9574	260.1864	111.9654	0.0000	0.0000	0.0000	0.0000	266.3636	546.7848	817.6496	(98)

Space heating 3849.1333 (98)
Space heating per m2 (98) / (4) = 30.2843 (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 %)	263.7800 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	1459.2211 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	786.3819	588.8440	470.9574	260.1864	111.9654	0.0000	0.0000	0.0000	0.0000	266.3636	546.7848	817.6496	(98)
Space heating efficiency (main heating system 1)	263.7800	263.7800	263.7800	263.7800	263.7800	0.0000	0.0000	0.0000	0.0000	263.7800	263.7800	263.7800	(210)
Space heating fuel (main heating system)	298.1204	223.2330	178.5418	98.6377	42.4465	0.0000	0.0000	0.0000	0.0000	100.9795	207.2882	309.9741	(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	157.0588	138.4602	146.8299	135.3996	134.8256	123.0857	121.8869	130.7654	129.5423	142.1175	146.0524	153.7723	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	92.2356	81.3133	86.2285	79.5159	79.1788	72.2843	71.5803	76.7943	76.0760	83.4611	85.7719	90.3056	(219)

Water heating fuel used	974.7455 (219)
Annual totals kWh/year	
Space heating fuel - main system	1459.2211 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)	
mechanical ventilation fans (SFP = 0.2294)	91.6088 (230a)
Total electricity for the above, kWh/year	91.6088 (231)
Electricity for lighting (calculated in Appendix L)	463.1819 (232)
Total delivered energy for all uses	2988.7574 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1459.2211	13.1900	192.4713	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	974.7455	13.1900	128.5689	(247)
Mechanical ventilation fans	91.6088	13.1900	12.0832	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	463.1819	13.1900	61.0937	(250)
Additional standing charges			0.0000	(251)
Total energy cost			394.2171	(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] =	0.9621	(257)
SAP value	86.5792	
SAP rating (Section 12)	87	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1459.2211	0.5190	757.3358	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	974.7455	0.5190	505.8929	(264)
Space and water heating			1263.2287	(265)
Pumps and fans	91.6088	0.5190	47.5450	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	1551.1651	(272)
CO2 emissions per m2	12.2000	(273)
EI value	87.9224	
EI rating	88	(274)
EI band	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.6378 = 5.000, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.6378 = 0.1968, stars = 5
Water heating energy efficiency	13.19 / 1.7028 = 7.746, stars = 3
Water heating environmental impact	0.519 / 1.7028 = 0.3048, stars = 5

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(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)	=	0.2005	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.5631	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1531	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

```
Daily hot water use
                113.0443   108.9336   104.8229   100.7122    96.6015    92.4908    92.4908    96.6015   100.7122   104.8229   108.9336   113.0443 (44)
Energy conte    167.6415   146.6203   151.2990   131.9062   126.5671   109.2178   101.2063   116.1358   117.5228   136.9615   149.5042   162.3518 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1616.9343 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 25.1462    21.9930    22.6949    19.7859    18.9851    16.3827    15.1810    17.4204    17.6284    20.5442    22.4256    24.3528 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                   1.5600 (48)
  Temperature factor from Table 2b                                                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                       0.8424 (55)
Total storage loss
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (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
                217.0183   191.2187   200.6758   179.6902   175.9439   157.0018   150.5831   165.5126   165.3068   186.3383   197.2882   211.7286 (62)
WWHRS           -59.9595   -52.7585   -53.8459   -44.2906   -41.1183   -33.9161   -28.6962   -34.7472   -35.7645   -44.2208   -51.2358   -57.9563 eq.(G10)
Total of WWHRS savings                                                                                                                      -538.5096
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
                157.0588   138.4602   146.8299   135.3996   134.8256   123.0857   121.8869   130.7654   129.5423   142.1175   146.0524   153.7723 (64)
                                                                                                     Total per year (kWh/year) = Sum(64)m =   1659.7967 (64)
Heat gains from water heating, kWh/month
                 95.2422    84.4300    89.8084    82.0860    81.5850    74.5421    73.1525    78.1166    77.3035    85.0411    87.9373    93.4834 (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           173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 65.5682    58.2371    47.3616    35.8558    26.8026    22.6279    24.4502    31.7813    42.6568    54.1627    63.2158    67.3905 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                439.0899   443.6463   432.1644   407.7207   376.8650   347.8649   328.4911   323.9347   335.4167   359.8603   390.7161   419.7161 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094 (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)
               -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823 (71)
Water heating gains (Table 5)
                128.0138   125.6398   120.7102   114.0083   109.6573   103.5307    98.3233   104.9954   107.3660   114.3026   122.1352   125.6498 (72)
Total internal gains
                745.6224   740.4738   713.1867   670.5354   626.2754   586.9741   564.2152   573.6620   598.3900   641.2761   689.0176   725.7070 (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                                       4.9200          11.9814            0.4600            0.0000       0.7700           20.8796 (74)
East                                        2.3100          22.3313            0.4600            0.0000       0.7700           18.2715 (76)
South                                      10.8500          50.9848            0.4600            0.0000       0.7700          195.9382 (78)
West                                        1.5300          22.3313            0.4600            0.0000       0.7700           12.1019 (80)
North                                      12.2300          11.9814            0.4300            0.0000       0.7700           48.5171 (74)
---------------------------------------------------------------------------------------------------------------------------------------------

Solar gains    295.7084   461.8301   652.7427   892.3490  1032.0608  1125.3730  1061.2661   948.3920   785.9961   552.6784   364.4663   249.7076 (83)
Total gains   1041.3308  1202.3039  1365.9293  1562.8844  1658.3361  1712.3470  1625.4813  1522.0540  1384.3861  1193.9545  1053.4839   975.4146 (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             34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557
alpha            3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904
util living area
                 0.9597     0.9369     0.8869     0.7821     0.6215     0.4126     0.2765     0.3037     0.5597     0.8185     0.9309     0.9661 (86)

Tweekday        18.0154    18.3338    18.8812    19.4480    19.8095    19.9397    19.9561    19.9553    19.8950    19.4704    18.6679    17.9246
Tweekend        20.0381    20.1830    20.4350    20.7076    20.8975    20.9809    20.9964    20.9951    20.9457    20.7107    20.3318    19.9969
24 / 16               0          0          0          0          0          0          0          0          0          0          0          0
24 / 9                0          0          0          0          0          0          0          0          0          0          0          0
16 / 9                0          0          0          0          0          0          0          0          0          0          0          0
MIT             19.5155    19.7362    20.1280    20.5435    20.8418    20.9707    20.9945    20.9924    20.9151    20.5534    19.9567    19.4519 (87)
Th 2            19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577    19.9577 (88)
util rest of house
                 0.9519     0.9253     0.8661     0.7440     0.5603     0.3323     0.1849     0.2068     0.4761     0.7766     0.9158     0.9594 (89)
Tweekday        18.0154    18.3338    18.8812    19.4480    19.8095    19.9397    19.9561    19.9553    19.8950    19.4704    18.6679    17.9246
Tweekend        18.0154    18.3338    18.8812    19.4480    19.8095    19.9397    19.9561    19.9553    19.8950    19.4704    18.6679    17.9246
MIT 2           18.0154    18.3338    18.8812    19.4480    19.8095    19.9397    19.9561    19.9553    19.8950    19.4704    18.6679    17.9246 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.1334 (91)
MIT             18.2155    18.5209    19.0476    19.5942    19.9472    20.0773    20.0947    20.0937    20.0312    19.6149    18.8398    18.1284 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT    18.2155    18.5209    19.0476    19.5942    19.9472    20.0773    20.0947    20.0937    20.0312    19.6149    18.8398    18.1284 (93)


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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9343	0.9045	0.8442	0.7291	0.5597	0.3418	0.1971	0.2197	0.4823	0.7606	0.8948	0.9432	(94)
Useful gains	972.9029	1087.5018	1153.0718	1139.5645	928.1368	585.2618	320.4059	334.3532	667.7006	908.1729	942.6132	919.9775	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1922.2542	1893.7303	1707.1078	1420.8130	1018.2075	597.5759	321.6561	336.1762	708.0700	1174.6850	1588.7209	1909.4841	(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	706.3174	541.7856	412.2027	202.4989	67.0126	0.0000	0.0000	0.0000	0.0000	198.2850	465.1976	736.1929	(98)
Space heating												3329.4927	(98)
Space heating per m2											(98) / (4) =	26.1959	(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 %)	263.7802	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1262.2226	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	706.3174	541.7856	412.2027	202.4989	67.0126	0.0000	0.0000	0.0000	0.0000	198.2850	465.1976	736.1929	(98)
Space heating efficiency (main heating system 1)	263.7802	263.7802	263.7802	263.7802	263.7802	0.0000	0.0000	0.0000	0.0000	263.7802	263.7802	263.7802	(210)
Space heating fuel (main heating system)	267.7674	205.3929	156.2675	76.7681	25.4047	0.0000	0.0000	0.0000	0.0000	75.1706	176.3581	279.0934	(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	157.0588	138.4602	146.8299	135.3996	134.8256	123.0857	121.8869	130.7654	129.5423	142.1175	146.0524	153.7723	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	92.2356	81.3133	86.2285	79.5159	79.1788	72.2843	71.5803	76.7943	76.0760	83.4611	85.7719	90.3056	(219)
Water heating fuel used												974.7455	(219)

Annual totals kWh/year		
Space heating fuel - main system	1262.2226	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)	91.6088	(230a)
Total electricity for the above, kWh/year	91.6088	(231)
Electricity for lighting (calculated in Appendix L)	463.1819	(232)
Total delivered energy for all uses	2791.7589	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1262.2226	16.9600	214.0730	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	974.7455	16.9600	165.3168	(247)
Mechanical ventilation fans	91.6088	16.9600	15.5369	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	463.1819	16.9600	78.5556	(250)
Additional standing charges			0.0000	(251)
Total energy cost			473.4823	(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	1262.2226	0.5190	655.0935	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	974.7455	0.5190	505.8929	(264)
Space and water heating			1160.9865	(265)
Pumps and fans	91.6088	0.5190	47.5450	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)
Total kg/year			1448.9229	(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	1262.2226	3.0700	3875.0234	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)

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

Water heating (other fuel)	974.7455	3.0700	2992.4688 (264)
Space and water heating			6867.4922 (265)
Pumps and fans	91.6088	3.0700	281.2392 (267)
Energy for lighting	463.1819	3.0700	1421.9684 (268)
Primary energy kWh/year			8570.6998 (272)
Primary energy kWh/m2/year			67.4327 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
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	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.7	-£ 65	-200 kg (13.8%)
U Solar photovoltaic panels	+ 7.8	-£ 309	-947 kg (75.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£65	1.58 kg/m²	B 88	B 89
Solar photovoltaic panels	£309	7.45 kg/m²	A 96	A 96
Total Savings	£375	9.03 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£473	£408	£65
Space heating	£230	£230	-£0
Water heating	£165	£100	£66
Lighting	£79	£79	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£473	£99	£374
Total cost of uses	£474	£100	£375
Delivered energy	22 kWh/m²	5 kWh/m²	17 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	11 kg/m²	2 kg/m²	9 kg/m²
Primary energy	67 kWh/m²	14 kWh/m²	53 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		327.2825	(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							0 * 10 =		0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(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) =	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.6105	54.0691	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	147.1720	146.6306	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.6195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1579	1.1537	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1536	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use													
	113.0443	108.9336	104.8229	100.7122	96.6015	92.4908	92.4908	96.6015	100.7122	104.8229	108.9336	113.0443	(44)
Energy conte	167.6415	146.6203	151.2990	131.9062	126.5671	109.2178	101.2063	116.1358	117.5228	136.9615	149.5042	162.3518	(45)
Energy content (annual)										Total = Sum(45)m =		1616.9343	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.1462	21.9930	22.6949	19.7859	18.9851	16.3827	15.1810	17.4204	17.6284	20.5442	22.4256	24.3528	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8424	(55)
Total storage loss													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(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													
	217.0183	191.2187	199.2801	172.9366	163.1496	144.3951	137.5562	153.4161	159.9039	184.9425	197.2882	211.7286	(62)
WWHRS	-59.9595	-52.7585	-53.8459	-44.2906	-41.1183	-33.9161	-28.6962	-34.7472	-35.7645	-44.2208	-51.2358	-57.9563	eq.(G10)
Total of WWHRS savings												-538.5096	
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												1.6817	(H8)
Utilisation factor												0.4482	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												102.7676	(H14)
Volume ratio Veff/V												0.7298	(H15)
Solar storage volume factor												0.9370	(H16)
Solar input												-669.7642	(H17)
Solar input	-19.4218	-32.4094	-55.1970	-73.9749	-91.3897	-89.8506	-88.6632	-77.4655	-60.6710	-41.4312	-23.0371	-16.2528	(63)
								Solar input (sum of months) = Sum(63)m =				-669.7642	(63)
Output from w/h													
	137.6370	106.0508	90.2372	54.6712	30.6416	20.6283	20.1968	41.2034	63.4684	99.2906	123.0153	137.5196	(64)
								Total per year (kWh/year) = Sum(64)m =				924.5601	(64)
Heat gains from water heating, kWh/month													
	95.2422	84.4300	88.6918	76.6831	71.3495	64.4567	62.7310	68.4394	72.9812	83.9245	87.9373	93.4834	(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	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	173.2234	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.5682	58.2371	47.3616	35.8558	26.8026	22.6279	24.4502	31.7813	42.6568	54.1627	63.2158	67.3905	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	439.0899	443.6463	432.1644	407.7207	376.8650	347.8649	328.4911	323.9347	335.4167	359.8603	390.7161	419.7161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	55.2094	(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)													
	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	-115.4823	(71)
Water heating gains (Table 5)													
	128.0138	125.6398	119.2094	106.5043	95.8999	89.5233	84.3159	91.9885	101.3628	112.8018	122.1352	125.6498	(72)
Total internal gains													
	745.6224	740.4738	711.6859	663.0314	612.5180	572.9666	550.2077	560.6551	592.3868	639.7753	689.0176	725.7070	(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	4.9200	10.6334	0.4600	0.0000	0.7700	18.5304	(74)
East	2.3100	19.6403	0.4600	0.0000	0.7700	16.0697	(76)
South	10.8500	46.7521	0.4600	0.0000	0.7700	179.6715	(78)
West	1.5300	19.6403	0.4600	0.0000	0.7700	10.6436	(80)
North	12.2300	10.6334	0.4300	0.0000	0.7700	43.0584	(74)

Solar gains	267.9735	464.2117	660.8888	870.4025	1028.0329	1045.5823	997.5363	875.0441	732.1091	519.4950	322.2580	228.5638	(83)
Total gains	1013.5959	1204.6855	1372.5747	1533.4338	1640.5509	1618.5489	1547.7440	1435.6992	1324.4959	1159.2703	1011.2756	954.2708	(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	34.2135	34.3399	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	34.3557	
alpha	3.2809	3.2893	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	3.2904	
util living area													
	0.9671	0.9433	0.9008	0.8193	0.6916	0.5347	0.4027	0.4480	0.6552	0.8592	0.9471	0.9725	(86)
Tweekday	17.7795	18.1831	18.7129	19.2818	19.6956	19.8935	19.9449	19.9380	19.8171	19.2815	18.4217	17.6877	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Tweekend	19.9337	20.1153	20.3577	20.6263	20.8349	20.9476	20.9844	20.9776	20.8963	20.6183	20.2200	19.8913	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.3543	19.6315	20.0087	20.4165	20.7452	20.9195	20.9759	20.9655	20.8380	20.4109	19.7820	19.2888	(87)
Th 2	19.9538	19.9572	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	(88)
util rest of house	0.9610	0.9331	0.8831	0.7877	0.6401	0.4609	0.3129	0.3548	0.5833	0.8268	0.9358	0.9672	(89)
Tweekday	17.7795	18.1831	18.7129	19.2818	19.6956	19.8935	19.9449	19.9380	19.8171	19.2815	18.4217	17.6877	
Tweekend	17.7795	18.1831	18.7129	19.2818	19.6956	19.8935	19.9449	19.9380	19.8171	19.2815	18.4217	17.6877	
MIT 2	17.7795	18.1831	18.7129	19.2818	19.6956	19.8935	19.9449	19.9380	19.8171	19.2815	18.4217	17.6877	(90)
Living area fraction									fLA = Living area / (4) =			0.1334	(91)
MIT	17.9897	18.3764	18.8858	19.4332	19.8356	20.0304	20.0825	20.0751	19.9533	19.4322	18.6032	17.9013	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9897	18.3764	18.8858	19.4332	19.8356	20.0304	20.0825	20.0751	19.9533	19.4322	18.6032	17.9013	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9129	0.8609	0.7695	0.6336	0.4663	0.3240	0.3657	0.5830	0.8073	0.9162	0.9527	(94)
Useful gains	957.7694	1099.7906	1181.5981	1179.9658	1039.4937	754.8055	501.4384	525.0650	772.1920	935.8904	926.5286	909.1156	(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	2014.7344	1976.0465	1815.2986	1543.7812	1192.3861	795.9021	510.4048	538.6369	857.8764	1294.4750	1685.9520	2008.1070	(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	786.3819	588.8440	471.4732	261.9470	113.7520	0.0000	0.0000	0.0000	0.0000	266.7869	546.7848	817.6496	(98)
Space heating												3853.6195	(98)
Space heating per m2											(98) / (4) =	30.3196	(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 %)	263.7800	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1460.9219	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	786.3819	588.8440	471.4732	261.9470	113.7520	0.0000	0.0000	0.0000	0.0000	266.7869	546.7848	817.6496	(98)
Space heating efficiency (main heating system 1)	263.7800	263.7800	263.7800	263.7800	263.7800	0.0000	0.0000	0.0000	0.0000	263.7800	263.7800	263.7800	(210)
Space heating fuel (main heating system)	298.1204	223.2330	178.7373	99.3051	43.1238	0.0000	0.0000	0.0000	0.0000	101.1399	207.2882	309.9741	(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	137.6370	106.0508	90.2372	54.6712	30.6416	20.6283	20.1968	41.2034	63.4684	99.2906	123.0153	137.5196	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	80.8298	62.2802	52.9934	32.1066	17.9948	12.1144	11.8609	24.1974	37.2729	58.3102	72.2429	80.7609	(219)
Water heating fuel used												542.9646	(219)

Annual totals kWh/year		
Space heating fuel - main system	1460.9219	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)	91.6088	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	141.6088	(231)
Electricity for lighting (calculated in Appendix L)	463.1819	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	(233)
Total delivered energy for all uses	881.4378	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1460.9219	13.1900	192.6956	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	542.9646	13.1900	71.6170	(247)
Mechanical ventilation fans	91.6088	13.1900	12.0832	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	463.1819	13.1900	61.0937	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)

Total energy cost		116.2617	(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] =	0.2837	(257)
SAP value		96.0420	
SAP rating (Section 12)		96	(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	1460.9219	0.5190	758.2185	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	542.9646	0.5190	281.7986	(264)
Space and water heating			1040.0171	(265)
Pumps and fans	141.6088	0.5190	73.4950	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			457.4662	(272)
CO2 emissions per m2			3.6000	(273)
EI value			96.4381	
EI rating			96	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	63.5500 (1b)	x	2.5400 (2b)	=	161.4170	(1b) - (3b)
First floor	63.5500 (1c)	x	2.6100 (2c)	=	165.8655	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	127.1000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	327.2825	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(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) =		0.2005	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Window (Uw = 1.20)			19.6100	1.1450	22.4542			(27)
French Door (Uw = 1.40)			12.2300	1.3258	16.2140			(27)
Front Door			2.1500	1.0000	2.1500			(26)
FP McCann System			63.5500	0.1100	6.9905	75.0000	4766.2500	(28a)
100mm Knauf Supafil 34	166.0400	33.9900	132.0500	0.2500	33.0125	52.8000	6972.2400	(29a)
Plane Ceiling-500mm Loft Roll	63.5500		63.5500	0.0900	5.7195	9.0000	571.9500	(30)
Total net area of external elements Aum(A, m2)			293.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.5407			(33)
1F Timber			113.4200			9.0000	1020.7800	(32c)
GF Masonry			77.8800			39.0000	3037.3200	(32c)
GF Timber			34.3900			9.0000	309.5100	(32c)
Internal Floor			63.5500			13.8000	876.9900	(32d)
Internal Ceiling			63.5500			9.0000	571.9500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 18126.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.6199	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.0208	(36)
Total fabric heat loss	(33) + (36) = 92.5615	(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	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	54.0016	(38)
Heat transfer coeff	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	146.5631	(39)
Average = Sum(39)m / 12 =												146.5631	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	1.1531	(40)
HLP (average)												1.1531	(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	2.8871	(42)
Average daily hot water use (litres/day)	102.7676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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

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Daily hot water use
                113.0443   108.9336   104.8229   100.7122    96.6015    92.4908    92.4908    96.6015   100.7122   104.8229   108.9336   113.0443 (44)
Energy conte    167.6415   146.6203   151.2990   131.9062   126.5671   109.2178   101.2063   116.1358   117.5228   136.9615   149.5042   162.3518 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1616.9343 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 25.1462    21.9930    22.6949    19.7859    18.9851    16.3827    15.1810    17.4204    17.6284    20.5442    22.4256    24.3528 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                   1.5600 (48)
  Temperature factor from Table 2b                                                                                                               0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                       0.8424 (55)
Total storage loss
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                 26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (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
                217.0183   191.2187   199.2801   172.9366   163.1496   144.3951   137.5562   153.4161   159.9039   184.9425   197.2882   211.7286 (62)
WWHRS           -59.9595   -52.7585   -53.8459   -44.2906   -41.1183   -33.9161   -28.6962   -34.7472   -35.7645   -44.2208   -51.2358   -57.9563 eq.(G10)
Total of WWHRS savings                                                                                                                      -538.5096
Aperture area of solar collector                                                                                                               3.0000 (H1)
Zero-loss collector efficiency                                                                                                                 0.7000 (H2)
Collector heat loss coefficient                                                                                                                1.8000 (H3)
Collector 2nd order heat loss coefficient                                                                                                      0.0050 (H3a)
Collector effective heat loss coefficient                                                                                                      1.8063 (H3b)
Collector performance ratio                                                                                                                    2.5804 (H4)
Annual solar radiation per m2                                                                                                               1140.0998 (H5)
Overshading factor                                                                                                                             0.8000 (H6)
Solar energy available                                                                                                                      1915.3676 (H7)
Adjustment factor for showers                                                                                                                  1.0000 (H7a)
Solar-to-load ratio                                                                                                                            1.7761 (H8)
Utilisation factor                                                                                                                             0.4305 (H9)
Collector performance factor                                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                                75.0000 (H11)
Effective solar volume                                                                                                                        75.0000 (H13)
Daily hot water demand                                                                                                                       102.7676 (H14)
Volume ratio Veff/V                                                                                                                            0.7298 (H15)
Solar storage volume factor                                                                                                                    0.9370 (H16)
Solar input                                                                                                                                 -679.3979 (H17)
Solar input     -20.9115   -31.4300   -52.9321   -73.1683   -88.1193   -92.7417   -90.5148   -80.8303   -63.0883   -42.9178   -25.4185   -17.3253 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =   -679.3979 (63)
Output from w/h
                136.1473   107.0302    92.5021    55.4777    33.9120    17.7373    18.3452    37.8387    61.0511    97.8040   120.6339   136.4470 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =    914.9264 (64)
Heat gains from water heating, kWh/month
                 95.2422    84.4300    88.6918    76.6831    71.3495    64.4567    62.7310    68.4394    72.9812    83.9245    87.9373    93.4834 (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           173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234   173.2234 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 65.5682    58.2371    47.3616    35.8558    26.8026    22.6279    24.4502    31.7813    42.6568    54.1627    63.2158    67.3905 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                439.0899   443.6463   432.1644   407.7207   376.8650   347.8649   328.4911   323.9347   335.4167   359.8603   390.7161   419.7161 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094    55.2094 (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)
               -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823  -115.4823 (71)
Water heating gains (Table 5)
                128.0138   125.6398   119.2094   106.5043    95.8999    89.5233    84.3159    91.9885   101.3628   112.8018   122.1352   125.6498 (72)
Total internal gains
                745.6224   740.4738   711.6859   663.0314   612.5180   572.9666   550.2077   560.6551   592.3868   639.7753   689.0176   725.7070 (73)


-----------------------------------------------------------------------------------------------------------
6. Solar gains
-----------------------------------------------------------------------------------------------------------

[Jan]                                     Area        Solar flux              g              FF          Access            Gains
                                           m2          Table 6a     Specific data    Specific data      factor               W
                                                          W/m2       or Table 6b      or Table 6c     Table 6d
-----------------------------------------------------------------------------------------------------------
North                                    4.9200          11.9814          0.4600           0.0000          0.7700          20.8796 (74)
East                                     2.3100          22.3313          0.4600           0.0000          0.7700          18.2715 (76)
South                                   10.8500          50.9848          0.4600           0.0000          0.7700         195.9382 (78)
West                                     1.5300          22.3313          0.4600           0.0000          0.7700          12.1019 (80)
North                                   12.2300          11.9814          0.4300           0.0000          0.7700          48.5171 (74)
-----------------------------------------------------------------------------------------------------------

Solar gains     295.7084   461.8301   652.7427   892.3490  1032.0608  1125.3730  1061.2661   948.3920   785.9961   552.6784   364.4663   249.7076 (83)
Total gains    1041.3308  1202.3039  1364.4285  1555.3804  1644.5788  1698.3396  1611.4738  1509.0471  1378.3829  1192.4537  1053.4839   975.4146 (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             34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557    34.3557
alpha            3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904     3.2904
util living area
                 0.9597     0.9369     0.8872     0.7838     0.6252     0.4156     0.2788     0.3062     0.5616     0.8190     0.9309     0.9661 (86)

Tweekday        18.0154    18.3338    18.8798    19.4438    19.8066    19.9393    19.9561    19.9553    19.8944    19.4694    18.6679    17.9246
```

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

Tweekend	20.0381	20.1830	20.4343	20.7054	20.8957	20.9805	20.9963	20.9950	20.9451	20.7101	20.3318	19.9969	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.5155	19.7362	20.1270	20.5400	20.8390	20.9701	20.9943	20.9922	20.9143	20.5526	19.9567	19.4519	(87)
Th 2	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	19.9577	(88)
util rest of house	0.9519	0.9253	0.8664	0.7459	0.5640	0.3349	0.1865	0.2086	0.4778	0.7771	0.9158	0.9594	(89)
Tweekday	18.0154	18.3338	18.8798	19.4438	19.8066	19.9393	19.9561	19.9553	19.8944	19.4694	18.6679	17.9246	
Tweekend	18.0154	18.3338	18.8798	19.4438	19.8066	19.9393	19.9561	19.9553	19.8944	19.4694	18.6679	17.9246	
MIT 2	18.0154	18.3338	18.8798	19.4438	19.8066	19.9393	19.9561	19.9553	19.8944	19.4694	18.6679	17.9246	(90)
Living area fraction									fLA = Living area / (4) =			0.1334	(91)
MIT	18.2155	18.5209	19.0462	19.5901	19.9444	20.0768	20.0946	20.0937	20.0305	19.6139	18.8398	18.1284	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2155	18.5209	19.0462	19.5901	19.9444	20.0768	20.0946	20.0937	20.0305	19.6139	18.8398	18.1284	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9343	0.9045	0.8445	0.7309	0.5631	0.3444	0.1988	0.2215	0.4840	0.7611	0.8948	0.9432	(94)
Useful gains	972.9029	1087.5018	1152.2135	1136.8740	926.1010	584.9146	320.3645	334.2942	667.1771	907.5577	942.6132	919.9775	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1922.2542	1893.7303	1706.9027	1420.2046	1017.7887	597.5097	321.6480	336.1647	707.9660	1174.5440	1588.7209	1909.4841	(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	706.3174	541.7856	412.6888	203.9980	68.2156	0.0000	0.0000	0.0000	0.0000	198.6378	465.1976	736.1929	(98)
Space heating												3333.0336	(98)
Space heating per m2											(98) / (4) =	26.2237	(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 %)	263.7802	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1263.5650	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	706.3174	541.7856	412.6888	203.9980	68.2156	0.0000	0.0000	0.0000	0.0000	198.6378	465.1976	736.1929	(98)
Space heating efficiency (main heating system 1)	263.7802	263.7802	263.7802	263.7802	263.7802	0.0000	0.0000	0.0000	0.0000	263.7802	263.7802	263.7802	(210)
Space heating fuel (main heating system)	267.7674	205.3929	156.4518	77.3364	25.8608	0.0000	0.0000	0.0000	0.0000	75.3043	176.3581	279.0934	(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	136.1473	107.0302	92.5021	55.4777	33.9120	17.7373	18.3452	37.8387	61.0511	97.8040	120.6339	136.4470	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	79.9549	62.8554	54.3235	32.5803	19.9154	10.4165	10.7735	22.2214	35.8533	57.4371	70.8444	80.1310	(219)
Water heating fuel used												537.3070	(219)
Annual totals kWh/year													
Space heating fuel - main system												1263.5650	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)

mechanical ventilation fans (SFP = 0.2294)	91.6088	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	141.6088	(231)
Electricity for lighting (calculated in Appendix L)	463.1819	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =	-1824.1596	-1824.1596	(233)
Total delivered energy for all uses		581.5031	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1263.5650	16.9600	214.3006	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	537.3070	16.9600	91.1273	(247)
Mechanical ventilation fans	91.6088	16.9600	15.5369	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	463.1819	16.9600	78.5556	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)

Total energy cost 98.6229 (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	1263.5650	0.5190	655.7902	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	537.3070	0.5190	278.8623	(264)
Space and water heating			934.6526	(265)
Pumps and fans	141.6088	0.5190	73.4950	(267)
Energy for lighting	463.1819	0.5190	240.3914	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			301.8001	(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	1263.5650	3.0700	3879.1445	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	537.3070	3.0700	1649.5325	(264)
Space and water heating			5528.6770	(265)
Pumps and fans	141.6088	3.0700	434.7392	(267)
Energy for lighting	463.1819	3.0700	1421.9684	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			1785.2145	(272)
Primary energy kWh/m2/year			14.0457	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	142.6 (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	432.01	(P1)
Transmission heat loss coefficient	92.56	(37)
Summer heat loss coefficient	524.57	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.9200	81.1852	0.4600	0.0000	0.9000	165.3645
East	2.3100	117.5071	0.4600	0.0000	0.9000	112.3767
South	10.8500	112.2060	0.4600	0.0000	0.9000	504.0181
West	1.5300	117.5071	0.4600	0.0000	0.9000	74.4313
North	12.2300	81.1852	0.4300	0.0000	0.9000	384.2502
total:						1240.4409

	Jun	Jul	Aug	
Solar gains	1315	1240	1109	(P4)
Internal gains	587	564	574	

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

Total summer gains	1902	1805	1682	(P5)
Summer gain/loss ratio	3.63	3.44	3.21	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 142.6)	1.00	1.00	1.00	
Threshold temperature	20.63	22.34	22.01	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			