elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 47

Contact: Tobias Whiting
Abacus Energy (UK) Ltd
toby@abacusenergyuk.com

Report Issue Date: 08/02/2024

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

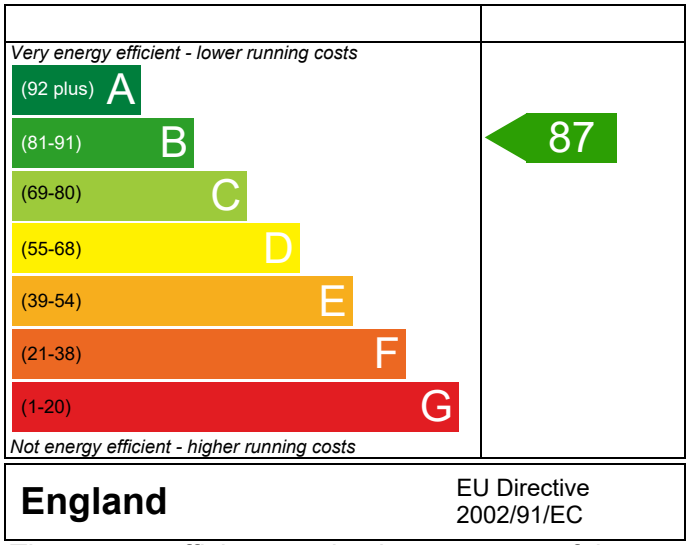
Plot 47

Dwelling type:	House, Semi-Detached
Date of assessment:	08/02/2024
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	71.62 m²
DRRN:	4728-8211-0042

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

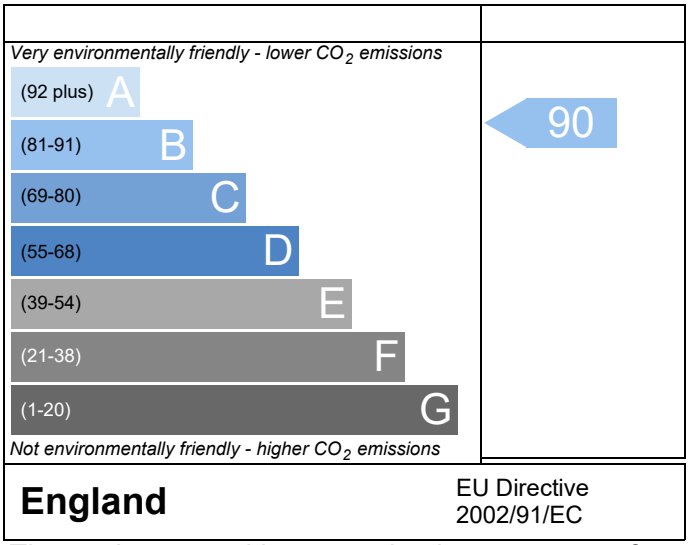
Energy Efficiency Rating



England EU Directive 2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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

elmhurst energy APPROVED ENERGY ASSESSOR

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r19

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Property	Plot 47		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	19.12	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.06	$kgCO_2/m^2$	Pass
	-5.06 (-26.5%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	54.02	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	44.96	$kWh/m^2/yr$	
	-9.0 (-16.7%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

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

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Vaillant ecoFIT sustain 830 VUW 306/6-3 (H-GB) Combi boiler Efficiency: 89.3% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Programmer, room thermostat and TRVs		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Slight		Pass

Based on:

Overshading	Average	
Windows facing North Windows facing South Windows facing West	7.82 m², No overhang 6.71 m², No overhang 4.10 m², No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	m³/(h.m²) @ 50 Pa	
Maximum	10.0	m³/(h.m²) @ 50 Pa	Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K
Door U-value	1.10	W/m²K
Photovoltaic array	0.60	kW

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

RECOMMENDATIONS

Design SAP
elmhurst energy

	Typical cost	Typical savings per year	Energy efficiency	Environmental impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£63	B 89	A 92	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£63**	**B 89**	**A 92**	

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

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Property	Plot 47		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.043	15.66	0.67	Catnic Thermally Broken
External wall	E3 Sill	Independently assessed	0.021	13.06	0.27	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	36.30	0.58	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	16.92	2.71	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	16.92	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	8.72	0.52	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	8.32	0.37	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	9.99	0.39	Knauf P23
External wall	E18 Party wall between dwellings	Independently assessed	0.036	9.99	0.36	Knauf P25 Halved
Party wall	P1 Party wall - Ground floor	Table K1 - Default	0.160	8.72	1.40	
Party wall	P2 Party wall - Intermediate floor within a dwelling	Table K1 - Default	0.000	8.72	0.00	
Party wall	P4 Party wall - Roof (insulation at ceiling level)	Independently assessed	0.035	8.72	0.31	Knauf P29 Halved

Total: 7.57 **W/mK:**

Y-Value: 0.048 **W/m²K:**

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

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Property	Plot 47		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 72 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.06 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.0 kWh/m²/yrOK

---
2 Fabric U-values

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

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

---
3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 830 VUW 306/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

---
6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.82 m², No overhang
Windows facing South: 6.71 m², No overhang
Windows facing West: 4.10 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.10 W/m²K
Photovoltaic array 0.60 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13538.4780	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							189.0321	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5746	(36)
Total fabric heat loss					(33) + (36) =		54.4408	(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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.0338	89.7989	89.5686	88.4871	88.2847	87.3427	87.3427	87.1683	87.7056	88.2847	88.6941	89.1220	(39)
Average = Sum(39)m / 12 =												88.4861	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2538	1.2506	1.2355	1.2327	1.2195	1.2195	1.2171	1.2246	1.2327	1.2384	1.2444	(40)
HLP (average)												1.2355	(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	2.2848	(42)
Average daily hot water use (litres/day)	88.4641	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              21.6463    18.9320    19.5361    17.0321    16.3427    14.1025    13.0680    14.9957    15.1748    17.6848    19.3044    20.9633 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     1.6149     1.3611     1.3515     1.1321     1.0419     0.8608     0.7977     0.9560     1.0086     1.2234     1.3878     1.5640 (61)
Total heat required for water heating calculated for each month
             145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (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
             145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   1406.1842 (64)
Heat gains from water heating, kWh/month
              48.3864    42.3062    43.6429    38.0374    36.4867    31.4757    29.1669    33.4796    33.8897    39.5072    43.1383    46.8596 (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        114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              17.9236    15.9196    12.9467     9.8015     7.3267     6.1855     6.6837     8.6877    11.6606    14.8058    17.2805    18.4217 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             201.0481   203.1344   197.8771   186.6849   172.5569   159.2785   150.4077   148.3215   153.5788   164.7709   178.8989   192.1773 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240 (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)
             -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921 (71)
Water heating gains (Table 5)
              65.0354    62.9556    58.6599    52.8297    49.0413    43.7162    39.2028    44.9994    47.0691    53.1011    59.9143    62.9833 (72)
Total internal gains
             344.2792   342.2816   329.7556   309.5882   289.1969   269.4523   256.5662   262.2806   272.5804   292.9498   316.3658   333.8544 (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                                    7.8200           10.6334           0.6300           0.7000           0.7700           25.4127 (74)
South                                    6.7100           46.7521           0.6300           0.7000           0.7700           95.8727 (78)
West                                     4.1000           19.6403           0.6300           0.7000           0.7700           24.6095 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains  145.8949   253.7212   361.8148   474.2360   555.8312   562.9148   538.0701   475.3259   400.3616   284.2893   175.6769   124.2658 (83)
Total gains  490.1741   596.0028   691.5704   783.8242   845.0281   832.3672   794.6363   737.6065   672.9420   577.2391   492.0427   458.1202 (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          41.7697    41.8790    41.9867    42.4999    42.5973    43.0567    43.0567    43.1429    42.8786    42.5973    42.4007    42.1971
alpha         3.7846     3.7919     3.7991     3.8333     3.8398     3.8704     3.8704     3.8762     3.8586     3.8398     3.8267     3.8131
util living area
               0.9903     0.9793     0.9552     0.8959     0.7818     0.6164     0.4682     0.5190     0.7501     0.9301     0.9819     0.9924 (86)

MIT          19.3850    19.6316    19.9863    20.4127    20.7442    20.9265    20.9804    20.9709    20.8396    20.3920    19.8059    19.3416 (87)
Th 2         19.8746    19.8772    19.8797    19.8917    19.8939    19.9044    19.9044    19.9063    19.9004    19.8939    19.8894    19.8847 (88)
util rest of house
               0.9877     0.9740     0.9436     0.8689     0.7277     0.5295     0.3586     0.4063     0.6716     0.9060     0.9764     0.9904 (89)
MIT 2        18.4184    18.6638    19.0127    19.4271    19.7210    19.8683    19.8985    19.8968    19.8097    19.4195    18.8479    18.3829 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.1917 (91)
MIT          18.6037    18.8494    19.1993    19.6160    19.9172    20.0712    20.1059    20.1027    20.0071    19.6059    19.0316    18.5667 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT 18.6037    18.8494    19.1993    19.6160    19.9172    20.0712    20.1059    20.1027    20.0071    19.6059    19.0316    18.5667 (93)


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

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9838     0.9677     0.9348     0.8611     0.7290     0.5435     0.3794     0.4274     0.6801     0.8983     0.9707     0.9872 (94)
Useful gains 482.2504   576.7676   646.4924   674.9541   616.0145   452.4033   301.4751   315.2539   457.6671   518.5194   477.6354   452.2358 (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
            1287.8152  1252.6366  1137.4615   948.2312   725.4490   477.8673   306.2169   322.7596   518.0875   795.0850  1058.2591  1280.3894 (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
             599.3402   454.1840   365.2810   196.7595    81.4193     0.0000     0.0000     0.0000     0.0000   205.7648   418.0491   616.1463 (98)
Space heating                                                                                                                 2936.9441 (98)
Space heating per m2                                                                                                 (98) / (4) =     41.0073 (99)


-------------------------------------------------------------------------------------------------------------------
8c. Space cooling requirement
```

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3256.0356	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	599.3402	454.1840	365.2810	196.7595	81.4193	0.0000	0.0000	0.0000	0.0000	205.7648	418.0491	616.1463	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	664.4570	503.5299	404.9678	218.1370	90.2653	0.0000	0.0000	0.0000	0.0000	228.1206	463.4691	683.0890	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	145.9236	127.5743	131.5923	114.6791	109.9930	94.8773	87.9178	100.9277	102.1742	119.1222	130.0835	141.3192	(64)
Efficiency of water heater												76.2000	(216)
(217)m	87.0678	86.7066	86.0147	84.4844	81.5864	76.2000	76.2000	76.2000	76.2000	84.5072	86.4314	87.2106	(217)
Fuel for water heating, kWh/month													
	167.5976	147.1333	152.9882	135.7400	134.8179	124.5110	115.3777	132.4510	134.0869	140.9610	150.5050	162.0435	(219)
Water heating fuel used												1698.2129	(219)
Annual totals kWh/year													
Space heating fuel - main system												3256.0356	(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)												316.5361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.60 * 1068 * 1.00) =										-512.6738		-512.6738	(233)
Total delivered energy for all uses												4833.1108	(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	3256.0356	0.2160	703.3037	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1698.2129	0.2160	366.8140	(264)
Space and water heating			1070.1177	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.5361	0.5190	164.2822	(268)
Energy saving/generation technologies				
PV Unit	-512.6738	0.5190	-266.0777	(269)
Total CO2, kg/year			1007.2472	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.0600	(273)

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

DER		14.0600	ZC1
Total Floor Area	TFA	71.6200	
Assumed number of occupants	N	2.2848	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6346	ZC2
CO2 emissions from cooking, equation (L16)		2.4272	ZC3
Total CO2 emissions		33.1218	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		33.1218	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	35.8100 (1b)	x	2.3900 (2b)	=	85.5859	(1b) - (3b)
First floor	35.8100 (1c)	x	2.6100 (2c)	=	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			15.7800	1.3258	20.9205			(27)
Ground Floor			35.8100	0.1300	4.6553			(28a)
Brick and Block	84.6000	17.9000	66.7000	0.1800	12.0060			(29a)
Pitched Roof	35.8100		35.8100	0.1300	4.6553			(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.3571			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2231	(36)
Total fabric heat loss					(33) + (36) =		54.5802	(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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.1731	89.9382	89.7079	88.6264	88.4240	87.4820	87.4820	87.3076	87.8449	88.4240	88.8334	89.2614	(39)
Average = Sum(39)m / 12 =												88.6254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2590	1.2558	1.2526	1.2375	1.2346	1.2215	1.2215	1.2190	1.2265	1.2346	1.2403	1.2463	(40)
HLP (average)												1.2374	(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												2.2848	(42)
Average daily hot water use (litres/day)												88.4641	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6463	18.9320	19.5361	17.0321	16.3427	14.1025	13.0680	14.9957	15.1748	17.6848	19.3044	20.9633	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.5884	43.1608	45.9819	42.7536	42.3755	39.2635	40.5723	42.3755	42.7536	45.9819	46.2437	49.5884	(61)
Total heat required for water heating calculated for each month													
	193.8970	169.3740	176.2227	156.3007	151.3266	133.2800	127.6924	142.3471	143.9192	163.8807	174.9394	189.3436	(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													
	193.8970	169.3740	176.2227	156.3007	151.3266	133.2800	127.6924	142.3471	143.9192	163.8807	174.9394	189.3436	(64)
								Total per year (kWh/year) = Sum(64)m =				1922.5235	(64)
Heat gains from water heating, kWh/month													
	60.3797	52.7561	54.8005	48.4428	46.8201	41.0764	39.1105	43.8344	44.3260	50.6968	54.3522	58.8657	(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	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9289	15.9243	12.9505	9.8044	7.3289	6.1874	6.6857	8.6903	11.6641	14.8102	17.2857	18.4272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.0481	203.1344	197.8771	186.6849	172.5569	159.2785	150.4077	148.3215	153.5788	164.7709	178.8989	192.1773	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	(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)													
	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	(71)
Water heating gains (Table 5)													
	81.1555	78.5061	73.6566	67.2817	62.9303	57.0505	52.5679	58.9173	61.5638	68.1409	75.4892	79.1206	(72)
Total internal gains													
	360.4046	357.8368	344.7563	324.0430	303.0881	282.7884	269.9333	276.2010	287.0787	307.9940	331.9459	349.9972	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.6200	10.6334	0.6300	0.7000	0.7700	21.5130	(74)
South	5.6900	46.7521	0.6300	0.7000	0.7700	81.2989	(78)
West	3.4700	19.6403	0.6300	0.7000	0.7700	20.8281	(80)

Solar gains	123.6400	215.0033	306.5652	401.7651	470.8476	476.8308	455.7925	402.6714	339.2071	240.8966	148.8762	105.3121	(83)
Total gains	484.0446	572.8401	651.3215	725.8081	773.9357	759.6192	725.7258	678.8724	626.2858	548.8906	480.8221	455.3092	(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	55.1562	55.3003	55.4423	56.1189	56.2473	56.8529	56.8529	56.9665	56.6181	56.2473	55.9881	55.7196	
alpha	4.6771	4.6867	4.6962	4.7413	4.7498	4.7902	4.7902	4.7978	4.7745	4.7498	4.7325	4.7146	
util living area													
	0.9966	0.9921	0.9802	0.9432	0.8502	0.6828	0.5181	0.5711	0.8130	0.9634	0.9929	0.9975	(86)
MIT	19.6840	19.8683	20.1474	20.4994	20.7877	20.9467	20.9885	20.9820	20.8746	20.4953	20.0229	19.6527	(87)
Th 2	19.8731	19.8756	19.8782	19.8902	19.8924	19.9029	19.9029	19.9048	19.8988	19.8924	19.8879	19.8831	(88)
util rest of house													
	0.9955	0.9895	0.9733	0.9225	0.7977	0.5869	0.3952	0.4453	0.7321	0.9458	0.9901	0.9966	(89)
MIT 2	18.1360	18.4057	18.8106	19.3146	19.6899	19.8686	19.8988	19.8978	19.8024	19.3202	18.6409	18.0973	(90)
Living area fraction										fLA = Living area / (4) =		0.1917	(91)
MIT	18.4327	18.6861	19.0669	19.5417	19.9004	20.0753	20.1077	20.1056	20.0080	19.5455	18.9058	18.3955	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4327	18.6861	19.0669	19.5417	19.9004	20.0753	20.1077	20.1056	20.0080	19.5455	18.9058	18.3955	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9854	0.9664	0.9144	0.7981	0.6031	0.4189	0.4693	0.7413	0.9385	0.9863	0.9948	(94)
Useful gains	480.7873	564.4739	629.4458	663.6908	617.6923	458.1121	303.9759	318.6261	464.2421	515.1424	474.2494	452.9623	(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													
	1274.3939	1239.8987	1127.3505	943.1375	725.1105	478.9907	306.8634	323.5289	518.9847	790.9945	1048.7528	1267.1094	(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													
	590.4433	453.8855	370.4411	201.2016	79.9191	0.0000	0.0000	0.0000	0.0000	205.2340	413.6424	605.7255	(98)
Space heating												2920.4925	(98)
Space heating per m2											(98) / (4) =	40.7776	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3126.8656	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	590.4433	453.8855	370.4411	201.2016	79.9191	0.0000	0.0000	0.0000	0.0000	205.2340	413.6424	605.7255	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	632.1663	485.9588	396.6179	215.4193	85.5665	0.0000	0.0000	0.0000	0.0000	219.7366	442.8720	648.5283	(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													
	193.8970	169.3740	176.2227	156.3007	151.3266	133.2800	127.6924	142.3471	143.9192	163.8807	174.9394	189.3436	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6739	87.4122	86.8775	85.6880	83.5251	80.3000	80.3000	80.3000	80.3000	85.6188	87.1423	87.7709	(217)
Fuel for water heating, kWh/month													
	221.1570	193.7648	202.8405	182.4068	181.1750	165.9776	159.0192	177.2692	179.2269	191.4075	200.7515	215.7247	(219)
Water heating fuel used												2270.7207	(219)
Annual totals kWh/year													
Space heating fuel - main system												3126.8656	(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)												316.6304	(232)
Total delivered energy for all uses												5789.2167	(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	3126.8656	0.2160	675.4030	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2270.7207	0.2160	490.4757	(264)
Space and water heating			1165.8786	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.6304	0.5190	164.3312	(268)
Total CO2, kg/m2/year			1369.1348	(272)
Emissions per m2 for space and water heating			16.2787	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2945	(272b)
Emissions per m2 for pumps and fans			0.5435	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2787 * 1.00) + 2.2945 + 0.5435, rounded to 2 d.p.			19.1200	(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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1676	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4176	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			9.0000	322.2900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13216.1880 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		184.5321 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.5746 (36)
Total fabric heat loss	(33) + (36) =	54.4408 (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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.0338	89.7989	89.5686	88.4871	88.2847	87.3427	87.3427	87.1683	87.7056	88.2847	88.6941	89.1220	(39)
Average = Sum(39)m / 12 =												88.4861	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2538	1.2506	1.2355	1.2327	1.2195	1.2195	1.2171	1.2246	1.2327	1.2384	1.2444	(40)
HLP (average)												1.2355	(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		2.2848 (42)
Average daily hot water use (litres/day)		88.4641 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     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
               30.6656    26.8203    27.6762    24.1288    23.1521    19.9785    18.5130    21.2440    21.4977    25.0535    27.3478    29.6980 (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         114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402   114.2402 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               17.9236    15.9196    12.9467     9.8015     7.3267     6.1855     6.6837     8.6877    11.6606    14.8058    17.2805    18.4217 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              201.0481   203.1344   197.8771   186.6849   172.5569   159.2785   150.4077   148.3215   153.5788   164.7709   178.8989   192.1773 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240    34.4240 (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)
              -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921 (71)
Water heating gains (Table 5)
               41.2172    39.9112    37.1991    33.5122    31.1184    27.7479    24.8831    28.5537    29.8579    33.6740    37.9831    39.9166 (72)
Total internal gains
              317.4609   316.2372   305.2949   287.2706   268.2741   250.4840   239.2465   242.8349   252.3693   270.5228   291.4347   307.7878 (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                                    7.8200           10.6334           0.6300           0.7000           0.7700           25.4127 (74)
South                                    6.7100           46.7521           0.6300           0.7000           0.7700           95.8727 (78)
West                                     4.1000           19.6403           0.6300           0.7000           0.7700           24.6095 (80)
-------------------------------------------------------------------------------------------------------------------------------

Solar gains   145.8949   253.7212   361.8148   474.2360   555.8312   562.9148   538.0701   475.3259   400.3616   284.2893   175.6769   124.2658 (83)
Total gains   463.3559   569.9584   667.1097   761.5066   824.1052   813.3988   777.3166   718.1608   652.7309   554.8121   467.1115   432.0536 (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           40.7754    40.8821    40.9872    41.4881    41.5832    42.0317    42.0317    42.1158    41.8578    41.5832    41.3913    41.1925
alpha          3.7184     3.7255     3.7325     3.7659     3.7722     3.8021     3.8021     3.8077     3.7905     3.7722     3.7594     3.7462
util living area
                0.9913     0.9809     0.9577     0.9003     0.7890     0.6254     0.4766     0.5298     0.7603     0.9349     0.9837     0.9932 (86)

MIT           19.3146    19.5679    19.9335    20.3755    20.7228    20.9181    20.9775    20.9666    20.8230    20.3518    19.7466    19.2712 (87)
Th 2          19.8746    19.8772    19.8797    19.8917    19.8939    19.9044    19.9044    19.9063    19.9004    19.8939    19.8894    19.8847 (88)
util rest of house
                0.9890     0.9761     0.9469     0.8745     0.7361     0.5387     0.3659     0.4160     0.6835     0.9125     0.9788     0.9915 (89)
MIT 2         18.3511    18.6035    18.9637    19.3944    19.7045    19.8635    19.8975    19.8951    19.7986    19.3839    18.7919    18.3155 (90)
Living area fraction                                                                                 fLA = Living area / (4) =     0.1917 (91)
MIT           18.5358    18.7883    19.1496    19.5825    19.8997    20.0657    20.1046    20.1005    19.9950    19.5695    18.9749    18.4987 (92)
Temperature adjustment                                                                                                        0.0000
adjusted MIT  18.5358    18.7883    19.1496    19.5825    19.8997    20.0657    20.1046    20.1005    19.9950    19.5695    18.9749    18.4987 (93)


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

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9854     0.9699     0.9380     0.8661     0.7364     0.5523     0.3868     0.4372     0.6909     0.9042     0.9733     0.9884 (94)
Useful gains  456.5699   552.7968   625.7490   659.5128   606.9103   449.2042   300.6704   313.9496   450.9637   501.6827   454.6212   427.0585 (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
            1281.7036  1247.1574  1133.0110   945.2587   723.9080   477.3854   306.0979   322.5684   517.0228   791.8684  1053.2353  1274.3301 (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
              613.8994   466.6103   377.4029   205.7371    87.0463     0.0000     0.0000     0.0000     0.0000   215.8982   431.0021   630.3701 (98)
Space heating                                                                                                                3027.9664 (98)
Space heating per m2                                                                                          (98) / (4) =    42.2782 (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   821.0215   646.3361   662.4788     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation     0.0000     0.0000     0.0000     0.0000     0.0000     0.8725     0.9216     0.9001     0.0000     0.0000     0.0000     0.0000 (101)
```

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	716.3212	595.6421	596.2766	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1035.5829	991.6842	923.9137	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	229.8685	294.6553	243.7620	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												768.2857	(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	57.4671	73.6638	60.9405	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												192.0714	(107)
Space cooling per m2												2.6818	(108)
Energy for space heating												42.2782	(99)
Energy for space cooling												2.6818	(108)
Total												44.9600	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.0	(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	35.8100 (1b)	x	2.3900 (2b)	=	85.5859	(1b) - (3b)
First floor	35.8100 (1c)	x	2.6100 (2c)	=	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			15.7800	1.3258	20.9205			(27)
Ground Floor			35.8100	0.1300	4.6553			(28a)
Brick and Block	84.6000	17.9000	66.7000	0.1800	12.0060			(29a)
Pitched Roof	35.8100		35.8100	0.1300	4.6553			(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.3571			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2231	(36)
Total fabric heat loss					(33) + (36) =		54.5802	(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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.1731	89.9382	89.7079	88.6264	88.4240	87.4820	87.4820	87.3076	87.8449	88.4240	88.8334	89.2614	(39)
Average = Sum(39)m / 12 =												88.6254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2590	1.2558	1.2526	1.2375	1.2346	1.2215	1.2215	1.2190	1.2265	1.2346	1.2403	1.2463	(40)
HLP (average)												1.2374	(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												2.2848	(42)
Average daily hot water use (litres/day)												88.4641	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(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													
	30.6656	26.8203	27.6762	24.1288	23.1521	19.9785	18.5130	21.2440	21.4977	25.0535	27.3478	29.6980	(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	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	114.2402	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9289	15.9243	12.9505	9.8044	7.3289	6.1874	6.6857	8.6903	11.6641	14.8102	17.2857	18.4272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.0481	203.1344	197.8771	186.6849	172.5569	159.2785	150.4077	148.3215	153.5788	164.7709	178.8989	192.1773	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	34.4240	(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)													
	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	(71)
Water heating gains (Table 5)													
	41.2172	39.9112	37.1991	33.5122	31.1184	27.7479	24.8831	28.5537	29.8579	33.6740	37.9831	39.9166	(72)
Total internal gains													
	317.4663	316.2419	305.2988	287.2735	268.2762	250.4858	239.2485	242.8375	252.3728	270.5272	291.4398	307.7932	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.6200	10.6334	0.6300	0.7000	0.7700	21.5130	(74)
South	5.6900	46.7521	0.6300	0.7000	0.7700	81.2989	(78)
West	3.4700	19.6403	0.6300	0.7000	0.7700	20.8281	(80)

Solar gains	123.6400	215.0033	306.5652	401.7651	470.8476	476.8308	455.7925	402.6714	339.2071	240.8966	148.8762	105.3121	(83)
Total gains	441.1063	531.2452	611.8640	689.0386	739.1239	727.3166	695.0410	645.5089	591.5799	511.4238	440.3160	413.1053	(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	55.1562	55.3003	55.4423	56.1189	56.2473	56.8529	56.8529	56.9665	56.6181	56.2473	55.9881	55.7196	
alpha	4.6771	4.6867	4.6962	4.7413	4.7498	4.7902	4.7902	4.7978	4.7745	4.7498	4.7325	4.7146	
util living area													
	0.9977	0.9942	0.9845	0.9523	0.8670	0.7049	0.5387	0.5964	0.8367	0.9717	0.9951	0.9983	(86)
MIT	19.6296	19.8166	20.1010	20.4628	20.7656	20.9389	20.9864	20.9785	20.8563	20.4542	19.9723	19.5990	(87)
Th 2	19.8731	19.8756	19.8782	19.8902	19.8924	19.9029	19.9029	19.9048	19.8988	19.8924	19.8879	19.8831	(88)
util rest of house													
	0.9969	0.9922	0.9788	0.9343	0.8177	0.6089	0.4121	0.4670	0.7598	0.9575	0.9931	0.9978	(89)
MIT 2	18.6329	18.8210	19.1043	19.4639	19.7374	19.8756	19.8996	19.8989	19.8214	19.4637	18.9864	18.6103	(90)
Living area fraction									fLA = Living area / (4) =			0.1917	(91)
MIT	18.8240	19.0119	19.2953	19.6554	19.9345	20.0795	20.1079	20.1059	20.0198	19.6536	19.1754	18.7998	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8240	19.0119	19.2953	19.6554	19.9345	20.0795	20.1079	20.1059	20.0198	19.6536	19.1754	18.7998	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9901	0.9750	0.9296	0.8198	0.6256	0.4366	0.4920	0.7696	0.9535	0.9912	0.9970	(94)
Useful gains	439.3008	525.9946	596.5518	640.5197	605.9578	454.9945	303.4371	317.5710	455.2836	487.6295	436.4544	411.8501	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1309.6736	1269.1952	1147.8426	953.2113	728.1270	479.3540	306.8814	323.5509	520.0198	800.5522	1072.7022	1303.1976	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	647.5574	499.4308	410.1603	225.1380	90.8939	0.0000	0.0000	0.0000	0.0000	232.8145	458.0985	663.1625	(98)
Space heating												3227.2559	(98)
Space heating per m2											(98) / (4) =	45.0608	(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	822.3311	647.3671	663.5377	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8758	0.9309	0.9087	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	720.1970	602.6233	602.9784	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	934.9698	895.5205	838.9993	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	154.6364	217.9155	175.5995	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												548.1515	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	38.6591	54.4789	43.8999	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												137.0379 (107)
Space cooling per m2												1.9134 (108)
Energy for space heating												45.0608 (99)
Energy for space cooling												1.9134 (108)
Total												46.9742 (109)
Target Fabric Energy Efficiency (TFEE)												54.0 (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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4525	0.4170	0.4082	0.3815	0.3815	0.3549	0.3549	0.3460	0.3549	0.3993	0.3904	0.4170	(22b)
Effective ac	0.6024	0.5870	0.5833	0.5728	0.5728	0.5630	0.5630	0.5599	0.5630	0.5797	0.5762	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13538.4780	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	189.0321	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.5746	(36)
Total fabric heat loss	(33) + (36) = 54.4408	(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	35.5930	34.6812	34.4649	33.8439	33.8439	33.2647	33.2647	33.0810	33.2647	34.2532	34.0462	34.6812	(38)
Heat transfer coeff	90.0338	89.1220	88.9057	88.2847	88.2847	87.7056	87.7056	87.5218	87.7056	88.6941	88.4871	89.1220	(39)
Average = Sum(39)m / 12 =												88.4644	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2444	1.2414	1.2327	1.2327	1.2246	1.2246	1.2220	1.2246	1.2384	1.2355	1.2444	(40)
HLP (average)												1.2352	(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	2.2848 (42)
Average daily hot water use (litres/day)	88.4641 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
               21.6463    18.9320    19.5361    17.0321    16.3427    14.1025    13.0680    14.9957    15.1748    17.6848    19.3044    20.9633 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss      1.6149     1.3611     1.3515     1.1321     1.0419     0.8608     0.7977     0.9560     1.0086     1.2234     1.3878     1.5640 (61)
Total heat required for water heating calculated for each month
              145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (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
              145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (64)
                                                                                               Total per year (kWh/year) = Sum(64)m =   1406.1842 (64)
RHI water heating demand                                                                                                                1406 (64)
Heat gains from water heating, kWh/month
               48.3864    42.3062    43.6429    38.0374    36.4867    31.4757    29.1669    33.4796    33.8897    39.5072    43.1383    46.8596 (65)
```

---

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m      137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               44.8090    39.7989    32.3667    24.5036    18.3168    15.4638    16.7092    21.7192    29.1515    37.0145    43.2014    46.0543 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              300.0718   303.1856   295.3389   278.6342   257.5476   237.7291   224.4891   221.3753   229.2220   245.9267   267.0134   286.8318 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936 (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)
              -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921 (71)
Water heating gains (Table 5)
               65.0354    62.9556    58.6599    52.8297    49.0413    43.7162    39.2028    44.9994    47.0691    53.1011    59.9143    62.9833 (72)
Total internal gains
              509.6059   505.6298   486.0551   455.6573   424.5953   396.5988   380.0908   387.7836   405.1322   435.7319   469.8187   495.5592 (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                                   7.8200           13.8645            0.6300              0.7000          0.7700           33.1348 (74)
South                                   6.7100           58.2505            0.6300              0.7000          0.7700          119.4522 (78)
West                                    4.1000           25.9136            0.6300              0.7000          0.7700           32.4701 (80)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    185.0571   275.5368   392.6601   527.8400   594.2497   652.7172   608.4276   546.5638   461.9497   326.9908   220.8846   150.4647 (83)
Total gains    694.6630   781.1666   878.7152   983.4973  1018.8450  1049.3161   988.5184   934.3474   867.0820   762.7227   690.7033   646.0239 (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            41.7697    42.1971    42.2997    42.5973    42.5973    42.8786    42.8786    42.9686    42.8786    42.4007    42.4999    42.1971
alpha           3.7846     3.8131     3.8200     3.8398     3.8398     3.8586     3.8586     3.8646     3.8586     3.8267     3.8333     3.8131
util living area
                0.9636     0.9452     0.8990     0.8024     0.6534     0.4544     0.3253     0.3428     0.5688     0.8187     0.9326     0.9699 (86)

MIT            19.8339    20.0055    20.3188    20.6535    20.8789    20.9771    20.9952    20.9943    20.9472    20.6949    20.2497    19.7993 (87)
Th 2           19.8746    19.8847    19.8871    19.8939    19.8939    19.9004    19.9004    19.9024    19.9004    19.8894    19.8917    19.8847 (88)
util rest of house
                0.9546     0.9324     0.8761     0.7609     0.5872     0.3707     0.2301     0.2430     0.4784     0.7679     0.9139     0.9622 (89)
MIT 2          18.8593    19.0324    19.3312    19.6381    19.8211    19.8913    19.8994    19.9012    19.8765    19.6795    19.2771    18.8343 (90)
Living area fraction                                                                                                 fLA = Living area / (4) =      0.1917 (91)
MIT            19.0461    19.2189    19.5205    19.8328    20.0239    20.0994    20.1095    20.1108    20.0818    19.8742    19.4636    19.0193 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT   19.0461    19.2189    19.5205    19.8328    20.0239    20.0994    20.1095    20.1108    20.0818    19.8742    19.4636    19.0193 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9463     0.9231     0.8673     0.7584     0.5955     0.3862     0.2484     0.2622     0.4941     0.7671     0.9051     0.9547 (94)
Useful gains  657.3408   721.0654   762.0883   745.8937   606.6881   405.2925   245.5365   244.9605   428.4036   585.1036   625.1434   616.7421 (95)
Ext temp.       5.4000     5.7000     7.3000     9.6000    12.6000    15.4000    17.3000    17.3000    15.0000    11.8000     8.4000     5.5000 (96)
Heat loss rate W
             1228.6143  1204.8353  1086.4730   903.3982   655.4192   412.1652   246.4067   246.0055   445.6989   716.1315   978.9815  1204.8671 (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
              425.0275   325.0934   241.3422   113.4033    36.2560     0.0000     0.0000     0.0000     0.0000    97.4847   254.7635   437.5650 (98)
Space heating                                                                                                                        1930.9356 (98)
RHI space heating demand                                                                                                                1931 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13538.4780	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	189.0321	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.5746	(36)
Total fabric heat loss	(33) + (36) = 54.4408	(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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.0338	89.7989	89.5686	88.4871	88.2847	87.3427	87.3427	87.1683	87.7056	88.2847	88.6941	89.1220	(39)
Average = Sum(39)m / 12 =												88.4861	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2538	1.2506	1.2355	1.2327	1.2195	1.2195	1.2171	1.2246	1.2327	1.2384	1.2444	(40)
HLP (average)												1.2355	(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	2.2848 (42)
Average daily hot water use (litres/day)	88.4641 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

```
Distribution loss  (46)m = 0.15 x (45)m
              21.6463    18.9320    19.5361    17.0321    16.3427    14.1025    13.0680    14.9957    15.1748    17.6848    19.3044    20.9633 (46)
Water storage loss:
Total storage loss
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss     1.6149     1.3611     1.3515     1.1321     1.0419     0.8608     0.7977     0.9560     1.0086     1.2234     1.3878     1.5640 (61)
Total heat required for water heating calculated for each month
             145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (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
             145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   1406.1842 (64)
Heat gains from water heating, kWh/month
              48.3864    42.3062    43.6429    38.0374    36.4867    31.4757    29.1669    33.4796    33.8897    39.5072    43.1383    46.8596 (65)


-------------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m       137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              44.8090    39.7989    32.3667    24.5036    18.3168    15.4638    16.7092    21.7192    29.1515    37.0145    43.2014    46.0543 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             300.0718   303.1856   295.3389   278.6342   257.5476   237.7291   224.4891   221.3753   229.2220   245.9267   267.0134   286.8318 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936 (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)
             -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921 (71)
Water heating gains (Table 5)
              65.0354    62.9556    58.6599    52.8297    49.0413    43.7162    39.2028    44.9994    47.0691    53.1011    59.9143    62.9833 (72)
Total internal gains
             509.6059   505.6298   486.0551   455.6573   424.5953   396.5988   380.0908   387.7836   405.1322   435.7319   469.8187   495.5592 (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                                    7.8200           10.6334           0.6300           0.7000           0.7700           25.4127 (74)
South                                    6.7100           46.7521           0.6300           0.7000           0.7700           95.8727 (78)
West                                     4.1000           19.6403           0.6300           0.7000           0.7700           24.6095 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains  145.8949   253.7212   361.8148   474.2360   555.8312   562.9148   538.0701   475.3259   400.3616   284.2893   175.6769   124.2658 (83)
Total gains  655.5008   759.3510   847.8699   929.8933   980.4265   959.5137   918.1608   863.1096   805.4938   720.0212   645.4956   619.8250 (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           41.7697    41.8790    41.9867    42.4999    42.5973    43.0567    43.0567    43.1429    42.8786    42.5973    42.4007    42.1971
alpha          3.7846     3.7919     3.7991     3.8333     3.8398     3.8704     3.8704     3.8762     3.8586     3.8398     3.8267     3.8131
util living area
               0.9752     0.9567     0.9211     0.8450     0.7179     0.5502     0.4101     0.4515     0.6687     0.8773     0.9581     0.9794 (86)

MIT           19.6290    19.8583    20.1776    20.5459    20.8131    20.9503    20.9875    20.9820    20.8937    20.5431    20.0214    19.5840 (87)
Th 2          19.8746    19.8772    19.8797    19.8917    19.8939    19.9044    19.9044    19.9063    19.9004    19.8939    19.8894    19.8847 (88)
util rest of house
               0.9692     0.9467     0.9030     0.8105     0.6597     0.4675     0.3119     0.3500     0.5873     0.8418     0.9467     0.9744 (89)
MIT 2         18.6582    18.8835    19.1923    19.5428    19.7718    19.8808    19.9008    19.9007    19.8434    19.5520    19.0560    18.6219 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1917 (91)
MIT           18.8443    19.0703    19.3812    19.7351    19.9714    20.0859    20.1091    20.1080    20.0448    19.7420    19.2411    18.8064 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT  18.8443    19.0703    19.3812    19.7351    19.9714    20.0859    20.1091    20.1080    20.0448    19.7420    19.2411    18.8064 (93)


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

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9622     0.9378     0.8934     0.8050     0.6641     0.4818     0.3306     0.3692     0.5988     0.8361     0.9383     0.9682 (94)
Useful gains 630.7381   712.1382   757.5246   748.6104   651.1046   462.2553   303.5610   318.6885   482.3394   601.9755   605.6458   600.0986 (95)
Ext temp.      4.3000     4.9000     6.5000     8.9000    11.7000    14.6000    16.6000    16.4000    14.1000    10.6000     7.1000     4.2000 (96)
Heat loss rate W
            1309.4762  1272.4811  1153.7492   958.7657   730.2392   479.1502   306.4977   323.2163   521.3901   807.0981  1076.8395  1301.7493 (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
             504.9812   376.5504   294.7911   151.3118    58.8761     0.0000     0.0000     0.0000     0.0000   152.6112   339.2595   522.0281 (98)
Space heating                                                                                                                 2400.4095 (98)
Space heating per m2                                                                                                 (98) / (4) =     33.5159 (99)


-------------------------------------------------------------------------------------------------------------------
8c. Space cooling requirement
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2661.2079	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.9812	376.5504	294.7911	151.3118	58.8761	0.0000	0.0000	0.0000	0.0000	152.6112	339.2595	522.0281	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	559.8461	417.4617	326.8194	167.7514	65.2729	0.0000	0.0000	0.0000	0.0000	169.1921	376.1192	578.7452	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	145.9236	127.5743	131.5923	114.6791	109.9930	94.8773	87.9178	100.9277	102.1742	119.1222	130.0835	141.3192	(64)
Efficiency of water heater												76.2000	(216)
(217)m	86.6317	86.1926	85.3599	83.5795	80.5594	76.2000	76.2000	76.2000	76.2000	83.4766	85.8294	86.8025	(217)
Fuel for water heating, kWh/month													
	168.4412	148.0108	154.1617	137.2096	136.5365	124.5110	115.3777	132.4510	134.0869	142.7012	151.5606	162.8055	(219)
Water heating fuel used												1707.8538	(219)
Annual totals kWh/year													
Space heating fuel - main system												2661.2079	(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)												316.5361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.60 * 1068 * 1.00) =										-512.6738		-512.6738	(233)
Total delivered energy for all uses												4247.9240	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2661.2079	3.4800	92.6100	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1707.8538	3.4800	59.4333	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	316.5361	13.1900	41.7511	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-512.6738	13.1900	-67.6217	(252)
Total energy cost			256.0653	(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] =	0.9222	(257)
SAP value		87.1353	
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	2661.2079	0.2160	574.8209	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1707.8538	0.2160	368.8964	(264)
Space and water heating			943.7173	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.5361	0.5190	164.2822	(268)
Energy saving/generation technologies				
PV Unit	-512.6738	0.5190	-266.0777	(269)
Total kg/year			880.8468	(272)
CO2 emissions per m2			12.3000	(273)
EI value			89.8788	
EI rating			90	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9020 = 3.858, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9020 = 0.2395, stars = 4
Water heating energy efficiency	3.48 / 0.8194 = 4.247, stars = 4
Water heating environmental impact	0.216 / 0.8194 = 0.2636, stars = 4

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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4525	0.4170	0.4082	0.3815	0.3815	0.3549	0.3549	0.3460	0.3549	0.3993	0.3904	0.4170	(22b)
Effective ac	0.6024	0.5870	0.5833	0.5728	0.5728	0.5630	0.5630	0.5599	0.5630	0.5797	0.5762	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13538.4780 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		189.0321 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.5746 (36)
Total fabric heat loss	(33) + (36) =	54.4408 (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	35.5930	34.6812	34.4649	33.8439	33.8439	33.2647	33.2647	33.0810	33.2647	34.2532	34.0462	34.6812	(38)
Heat transfer coeff	90.0338	89.1220	88.9057	88.2847	88.2847	87.7056	87.7056	87.5218	87.7056	88.6941	88.4871	89.1220	(39)
Average = Sum(39)m / 12 =												88.4644	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2444	1.2414	1.2327	1.2327	1.2246	1.2246	1.2220	1.2246	1.2384	1.2355	1.2444	(40)
HLP (average)												1.2352	(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	2.2848 (42)
Average daily hot water use (litres/day)	88.4641 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

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

```
Distribution loss  (46)m = 0.15 x (45)m
               21.6463    18.9320    19.5361    17.0321    16.3427    14.1025    13.0680    14.9957    15.1748    17.6848    19.3044    20.9633 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Combi loss      1.6149     1.3611     1.3515     1.1321     1.0419     0.8608     0.7977     0.9560     1.0086     1.2234     1.3878     1.5640 (61)
Total heat required for water heating calculated for each month
              145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (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
              145.9236   127.5743   131.5923   114.6791   109.9930    94.8773    87.9178   100.9277   102.1742   119.1222   130.0835   141.3192 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   1406.1842 (64)
Heat gains from water heating, kWh/month
               48.3864    42.3062    43.6429    38.0374    36.4867    31.4757    29.1669    33.4796    33.8897    39.5072    43.1383    46.8596 (65)


-------------------------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882   137.0882 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               44.8090    39.7989    32.3667    24.5036    18.3168    15.4638    16.7092    21.7192    29.1515    37.0145    43.2014    46.0543 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              300.0718   303.1856   295.3389   278.6342   257.5476   237.7291   224.4891   221.3753   229.2220   245.9267   267.0134   286.8318 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936    50.9936 (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)
              -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921   -91.3921 (71)
Water heating gains (Table 5)
               65.0354    62.9556    58.6599    52.8297    49.0413    43.7162    39.2028    44.9994    47.0691    53.1011    59.9143    62.9833 (72)
Total internal gains
              509.6059   505.6298   486.0551   455.6573   424.5953   396.5988   380.0908   387.7836   405.1322   435.7319   469.8187   495.5592 (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                                    7.8200           13.8645            0.6300           0.7000           0.7700           33.1348 (74)
South                                    6.7100           58.2505            0.6300           0.7000           0.7700          119.4522 (78)
West                                     4.1000           25.9136            0.6300           0.7000           0.7700           32.4701 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains   185.0571   275.5368   392.6601   527.8400   594.2497   652.7172   608.4276   546.5638   461.9497   326.9908   220.8846   150.4647 (83)
Total gains   694.6630   781.1666   878.7152   983.4973  1018.8450  1049.3161   988.5184   934.3474   867.0820   762.7227   690.7033   646.0239 (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           41.7697    42.1971    42.2997    42.5973    42.5973    42.8786    42.8786    42.9686    42.8786    42.4007    42.4999    42.1971
alpha          3.7846     3.8131     3.8200     3.8398     3.8398     3.8586     3.8586     3.8646     3.8586     3.8267     3.8333     3.8131
util living area
                0.9636     0.9452     0.8990     0.8024     0.6534     0.4544     0.3253     0.3428     0.5688     0.8187     0.9326     0.9699 (86)

MIT           19.8339    20.0055    20.3188    20.6535    20.8789    20.9771    20.9952    20.9943    20.9472    20.6949    20.2497    19.7993 (87)
Th 2          19.8746    19.8847    19.8871    19.8939    19.8939    19.9004    19.9004    19.9024    19.9004    19.8894    19.8917    19.8847 (88)
util rest of house
                0.9546     0.9324     0.8761     0.7609     0.5872     0.3707     0.2301     0.2430     0.4784     0.7679     0.9139     0.9622 (89)
MIT 2         18.8593    19.0324    19.3312    19.6381    19.8211    19.8913    19.8994    19.9012    19.8765    19.6795    19.2771    18.8343 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1917 (91)
MIT           19.0461    19.2189    19.5205    19.8328    20.0239    20.0994    20.1095    20.1108    20.0818    19.8742    19.4636    19.0193 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT  19.0461    19.2189    19.5205    19.8328    20.0239    20.0994    20.1095    20.1108    20.0818    19.8742    19.4636    19.0193 (93)


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

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9463     0.9231     0.8673     0.7584     0.5955     0.3862     0.2484     0.2622     0.4941     0.7671     0.9051     0.9547 (94)
Useful gains  657.3408   721.0654   762.0883   745.8937   606.6881   405.2925   245.5365   244.9605   428.4036   585.1036   625.1434   616.7421 (95)
Ext temp.       5.4000     5.7000     7.3000     9.6000    12.6000    15.4000    17.3000    17.3000    15.0000    11.8000     8.4000     5.5000 (96)
Heat loss rate W
             1228.6143  1204.8353  1086.4730   903.3982   655.4192   412.1652   246.4067   246.0055   445.6989   716.1315   978.9815  1204.8671 (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
              425.0275   325.0934   241.3422   113.4033    36.2560     0.0000     0.0000     0.0000     0.0000    97.4847   254.7635   437.5650 (98)
Space heating                                                                                                                 1930.9356 (98)
Space heating per m2                                                                                                 (98) / (4) =     26.9608 (99)


-------------------------------------------------------------------------------------------------------------------
8c. Space cooling requirement
```

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2140.7268	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	425.0275	325.0934	241.3422	113.4033	36.2560	0.0000	0.0000	0.0000	0.0000	97.4847	254.7635	437.5650	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	471.2056	360.4140	267.5635	125.7242	40.1951	0.0000	0.0000	0.0000	0.0000	108.0762	282.4429	485.1053	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	145.9236	127.5743	131.5923	114.6791	109.9930	94.8773	87.9178	100.9277	102.1742	119.1222	130.0835	141.3192	(64)
Efficiency of water heater												76.2000	(216)
(217)m	86.1545	85.7594	84.7084	82.5722	79.2493	76.2000	76.2000	76.2000	76.2000	81.9225	84.9259	86.3280	(217)
Fuel for water heating, kWh/month													
	169.3744	148.7583	155.3473	138.8835	138.7936	124.5110	115.3777	132.4510	134.0869	145.4083	153.1730	163.7003	(219)
Water heating fuel used												1719.8652	(219)
Annual totals kWh/year													
Space heating fuel - main system												2140.7268	(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)												316.5361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.60 * 1212 * 1.00) =										-581.6683		-581.6683	(233)
Total delivered energy for all uses												3670.4597	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2140.7268	7.6100	162.9093	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1719.8652	7.6100	130.8817	(247)
Pumps and fans for heating	75.0000	31.0800	23.3100	(249)
Energy for lighting	316.5361	31.0800	98.3794	(250)
Additional standing charges			105.0000	(251)
Energy saving/generation technologies				
PV Unit	-581.6683	31.0800	-180.7825	(252)
Total energy cost			339.6980	(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	2140.7268	0.2160	462.3970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1719.8652	0.2160	371.4909	(264)
Space and water heating			833.8879	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.5361	0.5190	164.2822	(268)
Energy saving/generation technologies				
PV Unit	-581.6683	0.5190	-301.8859	(269)
Total kg/year			735.2092	(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	2140.7268	1.2200	2611.6867	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1719.8652	1.2200	2098.2355	(264)
Space and water heating			4709.9222	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	316.5361	3.0700	971.7659	(268)
Energy saving/generation technologies				
PV Unit	-581.6683	3.0700	-1785.7218	(269)
Primary energy kWh/year			4126.2162	(272)
Primary energy kWh/m2/year			57.6126	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 90

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 63	-197 kg (26.8%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£63	2.75 kg/m²	B 89	A 92
	Total Savings	£63	2.75 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£122	£137	-£16
Mains gas	£399	£320	£78
Space heating	£291	£291	£0
Water heating	£131	£68	£63
Lighting	£98	£98	£0
Generated (PV)	-£181	-£181	£0
Total cost of fuels	£340	£276	£62
Total cost of uses	£339	£276	£63
Delivered energy	51 kWh/m²	38 kWh/m²	14 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	3 kg/m²
Primary energy	58 kWh/m²	42 kWh/m²	15 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(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	0.4525	0.4436	0.4348	0.3904	0.3815	0.3372	0.3372	0.3283	0.3549	0.3815	0.3993	0.4170	(22b)
Effective ac	0.6024	0.5984	0.5945	0.5762	0.5728	0.5568	0.5568	0.5539	0.5630	0.5728	0.5797	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13538.4780	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							189.0321	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5746	(36)
Total fabric heat loss					(33) + (36) =		54.4408	(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	35.5930	35.3581	35.1278	34.0462	33.8439	32.9019	32.9019	32.7274	33.2647	33.8439	34.2532	34.6812	(38)
Heat transfer coeff	90.0338	89.7989	89.5686	88.4871	88.2847	87.3427	87.3427	87.1683	87.7056	88.2847	88.6941	89.1220	(39)
Average = Sum(39)m / 12 =												88.4861	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2538	1.2506	1.2355	1.2327	1.2195	1.2195	1.2171	1.2246	1.2327	1.2384	1.2444	(40)
HLP (average)												1.2355	(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	2.2848	(42)
Average daily hot water use (litres/day)	88.4641	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m													
	21.6463	18.9320	19.5361	17.0321	16.3427	14.1025	13.0680	14.9957	15.1748	17.6848	19.3044	20.9633	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	1.6149	1.3611	1.3515	1.1321	1.0419	0.8608	0.7977	0.9560	1.0086	1.2234	1.3878	1.5640	(61)
Total heat required for water heating calculated for each month													
	145.9236	127.5743	131.5923	114.6791	109.9930	94.8773	87.9178	100.9277	102.1742	119.1222	130.0835	141.3192	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1079.5246	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1813.6014	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.3030	(H8)
Utilisation factor	0.5358	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	88.4641	(H14)
Volume ratio Veff/V	0.8478	(H15)
Solar storage volume factor	0.9670	(H16)
Solar input	-826.2404	(H17)

Solar input	-23.9593	-39.9812	-68.0926	-91.2575	-112.7410	-110.8423	-109.3775	-95.5637	-74.8455	-51.1107	-28.4192	-20.0499	(63)
								Solar input (sum of months) = Sum(63)m =				-826.2404	(63)
Output from w/h													
	121.9642	87.5931	63.4997	23.4216	0.0000	0.0000	0.0000	5.3640	27.3287	68.0115	101.6643	121.2693	(64)
								Total per year (kWh/year) = Sum(64)m =				620.1164	(64)
Heat gains from water heating, kWh/month													
	48.3864	42.3062	43.6429	38.0374	36.4867	31.4757	29.1669	33.4796	33.8897	39.5072	43.1383	46.8596	(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	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.8090	39.7989	32.3667	24.5036	18.3168	15.4638	16.7092	21.7192	29.1515	37.0145	43.2014	46.0543	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.0718	303.1856	295.3389	278.6342	257.5476	237.7291	224.4891	221.3753	229.2220	245.9267	267.0134	286.8318	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	(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)													
	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	(71)
Water heating gains (Table 5)													
	65.0354	62.9556	58.6599	52.8297	49.0413	43.7162	39.2028	44.9994	47.0691	53.1011	59.9143	62.9833	(72)
Total internal gains													
	509.6059	505.6298	486.0551	455.6573	424.5953	396.5988	380.0908	387.7836	405.1322	435.7319	469.8187	495.5592	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.8200	10.6334	0.6300	0.7000	0.7700	25.4127	(74)
South	6.7100	46.7521	0.6300	0.7000	0.7700	95.8727	(78)
West	4.1000	19.6403	0.6300	0.7000	0.7700	24.6095	(80)

Solar gains	145.8949	253.7212	361.8148	474.2360	555.8312	562.9148	538.0701	475.3259	400.3616	284.2893	175.6769	124.2658	(83)
Total gains	655.5008	759.3510	847.8699	929.8933	980.4265	959.5137	918.1608	863.1096	805.4938	720.0212	645.4956	619.8250	(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	41.7697	41.8790	41.9867	42.4999	42.5973	43.0567	43.0567	43.1429	42.8786	42.5973	42.4007	42.1971	
alpha	3.7846	3.7919	3.7991	3.8333	3.8398	3.8704	3.8704	3.8762	3.8586	3.8398	3.8267	3.8131	
util living area													
	0.9752	0.9567	0.9211	0.8450	0.7179	0.5502	0.4101	0.4515	0.6687	0.8773	0.9581	0.9794	(86)
MIT	19.6290	19.8583	20.1776	20.5459	20.8131	20.9503	20.9875	20.9820	20.8937	20.5431	20.0214	19.5840	(87)
Th 2	19.8746	19.8772	19.8797	19.8917	19.8939	19.9044	19.9044	19.9063	19.9004	19.8939	19.8894	19.8847	(88)
util rest of house													
	0.9692	0.9467	0.9030	0.8105	0.6597	0.4675	0.3119	0.3500	0.5873	0.8418	0.9467	0.9744	(89)
MIT 2	18.6582	18.8835	19.1923	19.5428	19.7718	19.8808	19.9008	19.9007	19.8434	19.5520	19.0560	18.6219	(90)
Living area fraction									fLA = Living area / (4) =			0.1917	(91)
MIT	18.8443	19.0703	19.3812	19.7351	19.9714	20.0859	20.1091	20.1080	20.0448	19.7420	19.2411	18.8064	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8443	19.0703	19.3812	19.7351	19.9714	20.0859	20.1091	20.1080	20.0448	19.7420	19.2411	18.8064	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9622	0.9378	0.8934	0.8050	0.6641	0.4818	0.3306	0.3692	0.5988	0.8361	0.9383	0.9682	(94)
Useful gains	630.7381	712.1382	757.5246	748.6104	651.1046	462.2553	303.5610	318.6885	482.3394	601.9755	605.6458	600.0986	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1309.4762	1272.4811	1153.7492	958.7657	730.2392	479.1502	306.4977	323.2163	521.3901	807.0981	1076.8395	1301.7493	(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	504.9812	376.5504	294.7911	151.3118	58.8761	0.0000	0.0000	0.0000	0.0000	152.6112	339.2595	522.0281	(98)
Space heating												2400.4095	(98)
Space heating per m2											(98) / (4) =	33.5159	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2661.2079	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	504.9812	376.5504	294.7911	151.3118	58.8761	0.0000	0.0000	0.0000	0.0000	152.6112	339.2595	522.0281	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	559.8461	417.4617	326.8194	167.7514	65.2729	0.0000	0.0000	0.0000	0.0000	169.1921	376.1192	578.7452	(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	121.9642	87.5931	63.4997	23.4216	0.0000	0.0000	0.0000	5.3640	27.3287	68.0115	101.6643	121.2693	(64)
Efficiency of water heater												76.2000	(216)
(217)m	87.0873	87.1773	87.3555	88.0320	90.2000	76.2000	76.2000	76.2000	76.2000	85.3651	86.5342	87.1805	(217)
Fuel for water heating, kWh/month	140.0482	100.4769	72.6910	26.6058	0.0000	0.0000	0.0000	7.0393	35.8644	79.6713	117.4845	139.1014	(219)
Water heating fuel used												718.9829	(219)
Annual totals kWh/year													
Space heating fuel - main system												2661.2079	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												316.5361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.60 * 1068 * 1.00) =										-512.6738		-512.6738	(233)
Total delivered energy for all uses												3309.0530	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2661.2079	3.4800	92.6100	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	718.9829	3.4800	25.0206	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	316.5361	13.1900	41.7511	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-512.6738	13.1900	-67.6217	(252)
Total energy cost			228.2476	(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] =	0.8220	(257)
SAP value	88.5328	
SAP rating (Section 12)	89	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	2661.2079	0.2160	574.8209	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	718.9829	0.2160	155.3003	(264)
Space and water heating			730.1212	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	316.5361	0.5190	164.2822	(268)
Energy saving/generation technologies				
PV Unit	-512.6738	0.5190	-266.0777	(269)
Total kg/year			693.2007	(272)
CO2 emissions per m2			9.6800	(273)
EI value			92.0349	
EI rating			92	(274)
EI band			A	

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

SAP 2012 WORKSHEET FOR New Build (As 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	35.8100	(1b)	x 2.3900	(2b) =	85.5859	(1b) - (3b)
First floor	35.8100	(1c)	x 2.6100	(2c) =	93.4641	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		179.0500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1676	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4176	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3549	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4525	0.4170	0.4082	0.3815	0.3815	0.3549	0.3549	0.3460	0.3549	0.3993	0.3904	0.4170	(22b)
Effective ac	0.6024	0.5870	0.5833	0.5728	0.5728	0.5630	0.5630	0.5599	0.5630	0.5797	0.5762	0.5870	(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	
Front Door			2.1200	1.1000	2.3320			(26)
Windows (Uw = 1.20)			18.6300	1.1450	21.3321			(27)
Ground Floor			35.8100	0.1200	4.2972	90.0000	3222.9000	(28a)
Brick and Block	84.6000	20.7500	63.8500	0.2400	15.3240	42.2200	2695.7470	(29a)
Pitched Roof	35.8100		35.8100	0.1000	3.5810	9.1000	325.8710	(30)
Total net area of external elements Aum(A, m2)			156.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.8663			(33)
Party Wall 1			43.5600	0.0000	0.0000	110.0000	4791.6000	(32)
Ground Floor Stud			68.5000			9.0000	616.5000	(32c)
First Floor Stud			66.3000			9.0000	596.7000	(32c)
Internal Floor 1			35.8100			18.0000	644.5800	(32d)
Internal Ceiling 1			35.8100			18.0000	644.5800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13538.4780	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	189.0321	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.5746	(36)
Total fabric heat loss	(33) + (36) = 54.4408	(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	35.5930	34.6812	34.4649	33.8439	33.8439	33.2647	33.2647	33.0810	33.2647	34.2532	34.0462	34.6812	(38)
Heat transfer coeff	90.0338	89.1220	88.9057	88.2847	88.2847	87.7056	87.7056	87.5218	87.7056	88.6941	88.4871	89.1220	(39)
Average = Sum(39)m / 12 =												88.4644	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2571	1.2444	1.2414	1.2327	1.2327	1.2246	1.2246	1.2220	1.2246	1.2384	1.2355	1.2444	(40)
HLP (average)												1.2352	(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	2.2848	(42)
Average daily hot water use (litres/day)	88.4641	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3105	93.7719	90.2334	86.6948	83.1562	79.6177	79.6177	83.1562	86.6948	90.2334	93.7719	97.3105	(44)
Energy conte	144.3086	126.2133	130.2408	113.5471	108.9511	94.0165	87.1201	99.9716	101.1656	117.8988	128.6957	139.7552	(45)
Energy content (annual)										Total = Sum(45)m =		1391.8844	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	21.6463	18.9320	19.5361	17.0321	16.3427	14.1025	13.0680	14.9957	15.1748	17.6848	19.3044	20.9633	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	1.6149	1.3611	1.3515	1.1321	1.0419	0.8608	0.7977	0.9560	1.0086	1.2234	1.3878	1.5640	(61)
Total heat required for water heating calculated for each month	145.9236	127.5743	131.5923	114.6791	109.9930	94.8773	87.9178	100.9277	102.1742	119.1222	130.0835	141.3192	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1234.4649	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	2073.9010	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.4900	(H8)
Utilisation factor	0.4889	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	88.4641	(H14)
Volume ratio Veff/V	0.8478	(H15)
Solar storage volume factor	0.9670	(H16)
Solar input	-862.0597	(H17)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar input	-28.2900	-40.3848	-68.4454	-93.3980	-110.2300	-117.3056	-112.9747	-100.7883	-79.7680	-54.6170	-33.2605	-22.5974	(63)
Solar input (sum of months) = Sum(63)m =												-862.0597	(63)
Output from w/h	117.6336	87.1895	63.1469	21.2812	0.0000	0.0000	0.0000	0.1393	22.4062	64.5052	96.8230	118.7218	(64)
Total per year (kWh/year) = Sum(64)m =												591.8466	(64)
Heat gains from water heating, kWh/month	48.3864	42.3062	43.6429	38.0374	36.4867	31.4757	29.1669	33.4796	33.8897	39.5072	43.1383	46.8596	(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	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	137.0882	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.8090	39.7989	32.3667	24.5036	18.3168	15.4638	16.7092	21.7192	29.1515	37.0145	43.2014	46.0543	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	300.0718	303.1856	295.3389	278.6342	257.5476	237.7291	224.4891	221.3753	229.2220	245.9267	267.0134	286.8318	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	50.9936	(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)	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	-91.3921	(71)
Water heating gains (Table 5)	65.0354	62.9556	58.6599	52.8297	49.0413	43.7162	39.2028	44.9994	47.0691	53.1011	59.9143	62.9833	(72)
Total internal gains	509.6059	505.6298	486.0551	455.6573	424.5953	396.5988	380.0908	387.7836	405.1322	435.7319	469.8187	495.5592	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.8200	13.8645	0.6300	0.7000	0.7700	33.1348	(74)
South	6.7100	58.2505	0.6300	0.7000	0.7700	119.4522	(78)
West	4.1000	25.9136	0.6300	0.7000	0.7700	32.4701	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	185.0571	275.5368	392.6601	527.8400	594.2497	652.7172	608.4276	546.5638	461.9497	326.9908	220.8846	150.4647	(83)
Total gains	694.6630	781.1666	878.7152	983.4973	1018.8450	1049.3161	988.5184	934.3474	867.0820	762.7227	690.7033	646.0239	(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	41.7697	42.1971	42.2997	42.5973	42.5973	42.8786	42.8786	42.9686	42.8786	42.4007	42.4999	42.1971	
alpha	3.7846	3.8131	3.8200	3.8398	3.8398	3.8586	3.8586	3.8646	3.8586	3.8267	3.8333	3.8131	
util living area	0.9636	0.9452	0.8990	0.8024	0.6534	0.4544	0.3253	0.3428	0.5688	0.8187	0.9326	0.9699	(86)
MIT	19.8339	20.0055	20.3188	20.6535	20.8789	20.9771	20.9952	20.9943	20.9472	20.6949	20.2497	19.7993	(87)
Th 2	19.8746	19.8847	19.8871	19.8939	19.8939	19.9004	19.9004	19.9024	19.9004	19.8894	19.8917	19.8847	(88)
util rest of house	0.9546	0.9324	0.8761	0.7609	0.5872	0.3707	0.2301	0.2430	0.4784	0.7679	0.9139	0.9622	(89)
MIT 2	18.8593	19.0324	19.3312	19.6381	19.8211	19.8913	19.8994	19.9012	19.8765	19.6795	19.2771	18.8343	(90)
Living area fraction									fLA = Living area / (4) =			0.1917	(91)
MIT	19.0461	19.2189	19.5205	19.8328	20.0239	20.0994	20.1095	20.1108	20.0818	19.8742	19.4636	19.0193	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0461	19.2189	19.5205	19.8328	20.0239	20.0994	20.1095	20.1108	20.0818	19.8742	19.4636	19.0193	(93)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9463	0.9231	0.8673	0.7584	0.5955	0.3862	0.2484	0.2622	0.4941	0.7671	0.9051	0.9547	(94)
Useful gains	657.3408	721.0654	762.0883	745.8937	606.6881	405.2925	245.5365	244.9605	428.4036	585.1036	625.1434	616.7421	(95)
Ext temp.	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Heat loss rate W													
	1228.6143	1204.8353	1086.4730	903.3982	655.4192	412.1652	246.4067	246.0055	445.6989	716.1315	978.9815	1204.8671	(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													
	425.0275	325.0934	241.3422	113.4033	36.2560	0.0000	0.0000	0.0000	0.0000	97.4847	254.7635	437.5650	(98)
Space heating												1930.9356	(98)
Space heating per m2											(98) / (4) =	26.9608	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2140.7268	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	425.0275	325.0934	241.3422	113.4033	36.2560	0.0000	0.0000	0.0000	0.0000	97.4847	254.7635	437.5650	(98)
Space heating efficiency (main heating system 1)													
	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)													
	471.2056	360.4140	267.5635	125.7242	40.1951	0.0000	0.0000	0.0000	0.0000	108.0762	282.4429	485.1053	(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													
	117.6336	87.1895	63.1469	21.2812	0.0000	0.0000	0.0000	0.1393	22.4062	64.5052	96.8230	118.7218	(64)
Efficiency of water heater												76.2000	(216)
(217)m	86.7452	86.8264	86.8893	87.6553	90.2000	76.2000	76.2000	76.2000	76.2000	84.0508	85.8560	86.7966	(217)
Fuel for water heating, kWh/month													
	135.6081	100.4182	72.6751	24.2782	0.0000	0.0000	0.0000	0.1829	29.4044	76.7455	112.7737	136.7816	(219)
Water heating fuel used												688.8677	(219)
Annual totals kWh/year													
Space heating fuel - main system												2140.7268	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												316.5361	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.60 * 1212 * 1.00) =										-581.6683		-581.6683	(233)
Total delivered energy for all uses												2689.4623	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2140.7268	7.6100	162.9093	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	688.8677	7.6100	52.4228	(247)
Pumps and fans for heating	75.0000	31.0800	23.3100	(249)
Pump for solar water heating	50.0000	31.0800	15.5400	(249)
Energy for lighting	316.5361	31.0800	98.3794	(250)
Additional standing charges			105.0000	(251)
Energy saving/generation technologies				
PV Unit	-581.6683	31.0800	-180.7825	(252)
Total energy cost			276.7790	(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	2140.7268	0.2160	462.3970	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	688.8677	0.2160	148.7954	(264)
Space and water heating			611.1924	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	316.5361	0.5190	164.2822	(268)
Energy saving/generation technologies				
PV Unit	-581.6683	0.5190	-301.8859	(269)
Total kg/year			538.4638	(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	2140.7268	1.2200	2611.6867	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	688.8677	1.2200	840.4186	(264)
Space and water heating			3452.1053	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	316.5361	3.0700	971.7659	(268)
Energy saving/generation technologies				
PV Unit	-581.6683	3.0700	-1785.7218	(269)
Primary energy kWh/year			3021.8993	(272)
Primary energy kWh/m2/year			42.1935	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Project	Plot 47		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

Building Elements

Roof 000002 - Mineral Wool between and above

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	**Mineral wool batt**						
	Main construction	350	0.0380	9.2105	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**Mineral wool batt**						
	Main construction	100	0.0380	2.6316	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance: **Upper limit =** 11.772 m² K/W **Lower limit =** 11.430 m² K/W **Average =** 11.601 m² K/W

Total correction = 0.0096 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 463 mm **U-value: 0.10 W/m² K** **Kappa: 9.10 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Project	Plot 47		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

Building Elements

Wall 000001

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	**Brick, outer leaf**						
	Main construction	102	0.7700	0.1325	82.81		
	Main construction	102	0.9407	0.1084	17.19		
Layer 2	**Supafil 34**						
	Main construction	100	0.0340	2.9412	100.00		
	Corrections - Air Gap: Level 0, Fasteners: None or plastic						
Layer 3	**Supabloc**						
	Main construction	100	0.1100	0.9091	94.04	460	1000
	Main construction	100	0.8803	0.1136	5.96	460	1000
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**airspace/plaster dabs**						
	Main construction	15	0.0882	0.1700	80.00		
	Main construction	15	0.0882	0.1700	20.00		
	Corrections - Cavity Unventilated, Emissivity: Normal						
Layer 5	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1300			

Total resistance: **Upper limit =** 4.321 m² K/W **Lower limit =** 4.110 m² K/W **Average =** 4.215 m² K/W

Total correction = 0.0002 m² K/W **U-value (unrounded) =** 0.24 W/m² K

Unheated space: None

Total thickness: 330 mm **U-value: 0.24 W/m² K** **Kappa: 42.22 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Project	Plot 47		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

Building Elements

Floor 000003

Floor Type: Suspended Floor
Area = 43.48 m², Perimeter = 19.02 m, Wall thickness = 275.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.1700			
Layer 1	**EPS 200 Lower portion**						
	Main construction	55	0.0340	1.6176	80.65		
	Main construction	55	2.0000	0.0275	19.35		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**EPS Upper portion**						
	Main construction	100	0.0340	2.9412	87.10		
	Main construction	100	2.0000	0.0500	12.90		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Grey EPS 100 Topsheet**						
	Main construction	155	0.0300	5.1667	100.00	15	1450
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**Screed**						
	Main construction	75	1.1500	0.0652	100.00	1200	1000
Int surface				0.1700			

Total resistance: **Upper limit =** 9.271 m² K/W **Lower limit =** 6.052 m² K/W **Average =** 7.661 m² K/W

Total correction = 0.0046 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 385 mm **U-value: 0.12 W/m² K** **Kappa: 90.00 kJ/m² K**

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP 0931 Plot 47	**Issued on Date**	08/02/2024
Assessment Reference	Rev B	**Prop Type Ref**	Block L
Property	Plot 47		

SAP Rating	87 B	**DER**	14.06	**TER**	19.12
Environmental	90 B	**% DER<TER**	26.45		
CO_2 Emissions (t/year)	0.74	**DFEE**	44.96	**TFEE**	54.02
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.77		

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

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

Orientation	South
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2023
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.92 m	35.81 m²	2.39 m
1st Storey:	16.92 m	35.81 m²	2.61 m

7.0 Living Area	13.73	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	189.03	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Brick and Block	Cavity Wall	Other	0.24	42.22	84.60	63.85

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall 1	Filled Cavity with Edge Sealing	Single plasterboard on dabs both sides, lightweight aggregate blocks, cavity or cavity fill	0.00	110.00	43.56

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Ground Floor Stud	Plasterboard on timber frame	9.00	68.50
First Floor Stud	Plasterboard on timber frame	9.00	66.30

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Pitched Roof	External Plane Roof	Other	0.10	9.10	35.81	35.81

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	35.81

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.12	90.00	35.81

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	35.81

12.0 Opening Types

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

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] Brick and Block	South							2.12	
Windows	Window	[1] Brick and Block	South	None	0.00					6.71	
Side Elevation	Window	[1] Brick and Block	West	None	0.00					4.10	
Rear Elevation	Window	[1] Brick and Block	North	None	0.00					7.82	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	

17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	15.66	0.043	No	Catnic Thermally Broken
Independently assessed	E3 Sill	13.06	0.021	No	Knauf P5
Independently assessed	E4 Jamb	36.30	0.016	No	Knauf P6
Table K1 - Approved	E5 Ground floor (normal)	16.92	0.160	No	
Independently assessed	E6 Intermediate floor within a dwelling	16.92	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	8.72	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	8.32	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	9.99	0.039	No	Knauf P23
Independently assessed	E18 Party wall between dwellings	9.99	0.036	No	Knauf P25 Halved
Table K1 - Default	P1 Party wall - Ground floor	8.72	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	8.72	0.000	No	
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	8.72	0.035	No	Knauf P29 Halved

Y-value	0.048	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

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

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	17	
Total number of L.E.L. fittings	17	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	Yes	
Light and motion sensor	Yes	

23.0 Electricity Tariff	Standard	

24.0 Main Heating 1	Database	
Description	Gas Combi	
Percentage of Heat	100	%
Database Ref. No.	17959	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.2	
In Summer	76.2	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	

25.0 Main Heating 2	None	

Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
29.0 Hot Water Cylinder	None
32.0 Photovoltaic Unit	One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.60	South	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£63	B 89	