elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 67

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

Report Issue Date: 28/03/2023

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
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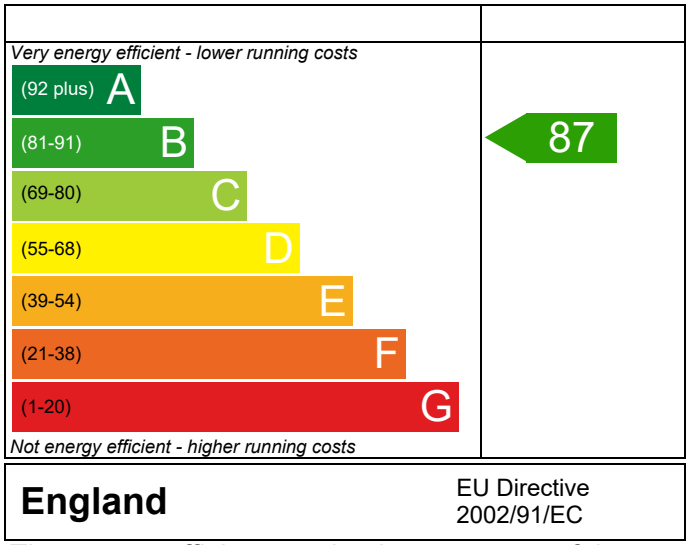
Plot 67

Dwelling type:	House, Semi-Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	71.04 m²
DRRN:	9227-4274-8051

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.

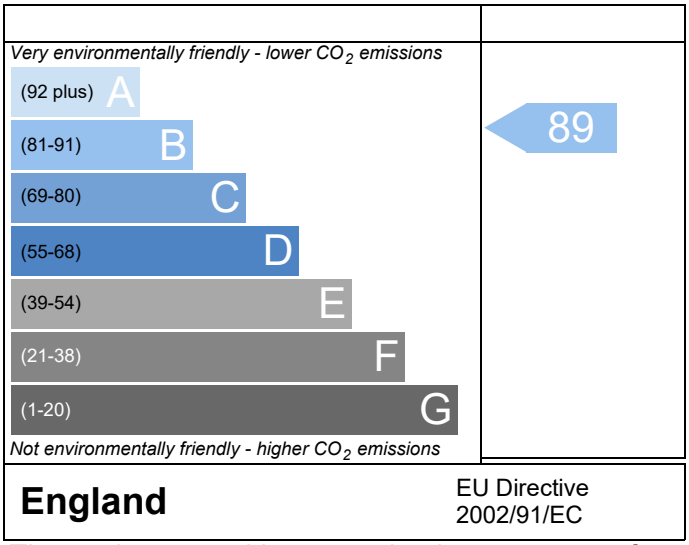
Energy Efficiency Rating



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 0879 Plot 67	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Property	Plot 67		

SAP Rating	87 B	**DER**	15.13	**TER**	19.36
Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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)	19.36	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.13	$kgCO_2/m^2$	Pass
	-4.23 (-21.8%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	53.36	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	51.31	$kWh/m^2/yr$	
	-2.1 (-3.9%)	$kWh/m^2/yr$	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	1.18 (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

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Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 32CDi Compact ErP Combi boiler Efficiency: 89.8% 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 East Windows facing South West	6.60 m², No overhang 3.49 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	0.85	kW

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RECOMMENDATIONS

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	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	£77	B 88	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£77**	**B 88**	**B 91**	

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THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
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Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Property	Plot 67		

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Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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	0.110	0.46	0.05	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.910	5.46	4.97	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	1.02	0.07	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	1.59	0.11	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	5.92	0.12	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	24.32	0.39	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Default	0.320	16.80	5.38	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	16.80	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	9.10	0.55	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	7.79	0.34	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	10.00	0.39	Knauf P23
External wall	E18 Party wall between dwellings	Table K1 - Approved	0.060	10.00	0.60	
Party wall	P1 Party wall - Ground floor	Table K1 - Default	0.160	7.79	1.25	
Party wall	P2 Party wall - Intermediate floor within a dwelling	Table K1 - Default	0.000	7.79	0.00	
Party wall	P4 Party wall - Roof (insulation at ceiling level)	Independently assessed	0.069	7.79	0.54	Knauf P29

Total: 14.75 **W/mK:**

Y-Value: 0.095 **W/m²K:**

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

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General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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 71 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) 19.36 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.13 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.3 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	1.18 (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
Worcester Greenstar 32CDi Compact ErP
Combi boiler
Efficiency: 89.8% 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 East: 6.60 m², No overhang
Windows facing South West: 3.49 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 0.85 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	89.0496	88.8151	88.5852	87.5053	87.3033	86.3628	86.3628	86.1886	86.7251	87.3033	87.7120	88.1393	(39)
Average = Sum(39)m / 12 =												87.5044	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2502	1.2470	1.2318	1.2289	1.2157	1.2157	1.2132	1.2208	1.2289	1.2347	1.2407	(40)
HLP (average)												1.2318	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
               21.5667    18.8624    19.4643    16.9694    16.2826    14.0506    13.0200    14.9406    15.1190    17.6198    19.2334    20.8862 (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     25.2901    22.8200    25.2287    24.3739    25.1566    24.3107    25.0997    25.1366    24.3452    25.1989    24.4335    25.2783 (61)
Total heat required for water heating calculated for each month
              169.0681   148.5691   154.9906   137.5035   133.7071   117.9815   111.8995   124.7406   125.1388   142.6641   152.6560   164.5196 (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
              169.0681   148.5691   154.9906   137.5035   133.7071   117.9815   111.8995   124.7406   125.1388   142.6641   152.6560   164.5196 (64)
                                                                                           Total per year (kWh/year) = Sum(64)m =    1683.4385 (64)
Heat gains from water heating, kWh/month
               54.1287    47.5166    49.4530    43.7091    42.3822    37.2232    35.1358    39.4025    39.6002    45.3569    48.7424    52.6173 (65)


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5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553   113.5553 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               19.0413    16.9123    13.7540    10.4127     7.7836     6.5712     7.1005     9.2294    12.3877    15.7291    18.3582    19.5705 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              199.7121   201.7845   196.5621   185.4444   171.4102   158.2200   149.4082   147.3358   152.5582   163.6759   177.7101   190.9002 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555    34.3555 (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)
              -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443 (71)
Water heating gains (Table 5)
               72.7537    70.7092    66.4691    60.7070    56.9653    51.6989    47.2256    52.9603    55.0002    60.9636    67.6977    70.7222 (72)
Total internal gains
              351.5736   349.4726   336.8518   316.6306   296.2257   276.5568   263.8009   269.5922   280.0127   300.4352   323.8326   341.2595 (73)


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

[Jan]                                       Area         Solar flux              g                FF             Access               Gains
                                              m2           Table 6a      Specific data     Specific data         factor                   W
                                                               W/m2        or Table 6b       or Table 6c       Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                 6.6000            11.2829             0.6300            0.7000             0.7700             22.7582 (75)
Southwest                                 3.4900            36.7938             0.6300            0.7000             0.7700             39.2439 (79)
----------------------------------------------------------------------------------------------------

Solar gains    62.0021   113.1719   174.9257   250.3970   311.1846   322.4466   305.2498   257.8336   200.7358   130.4929    75.6409    52.1701 (83)
Total gains   413.5757   462.6445   511.7776   567.0276   607.4103   599.0034   569.0506   527.4258   480.7485   430.9281   399.4735   393.4296 (84)


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7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            41.4150    41.5243    41.6321    42.1458    42.2434    42.7034    42.7034    42.7897    42.5250    42.2434    42.0465    41.8427
alpha           3.7610     3.7683     3.7755     3.8097     3.8162     3.8469     3.8469     3.8526     3.8350     3.8162     3.8031     3.7895
util living area
                0.9941     0.9903     0.9811     0.9547     0.8895     0.7606     0.6131     0.6688     0.8700     0.9686     0.9903     0.9952 (86)

MIT            19.2638    19.4308    19.7357    20.1610    20.5592    20.8420    20.9494    20.9288    20.7071    20.2041    19.6655    19.2374 (87)
Th 2           19.8774    19.8800    19.8826    19.8947    19.8969    19.9075    19.9075    19.9094    19.9034    19.8969    19.8924    19.8876 (88)
util rest of house
                0.9926     0.9877     0.9757     0.9405     0.8519     0.6769     0.4837     0.5427     0.8110     0.9560     0.9872     0.9939 (89)
MIT 2          18.3015    18.4696    18.7738    19.1994    19.5754    19.8214    19.8905    19.8830    19.7190    19.2485    18.7132    18.2828 (90)
Living area fraction                                                                                     fLA = Living area / (4) =       0.2500 (91)
MIT            18.5421    18.7099    19.0143    19.4398    19.8213    20.0765    20.1552    20.1444    19.9661    19.4874    18.9513    18.5215 (92)
Temperature adjustment                                                                                                                    0.0000
adjusted MIT   18.5421    18.7099    19.0143    19.4398    19.8213    20.0765    20.1552    20.1444    19.9661    19.4874    18.9513    18.5215 (93)


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8. Space heating requirement
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                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9900     0.9840     0.9702     0.9332     0.8488     0.6914     0.5152     0.5725     0.8150     0.9499     0.9836     0.9917 (94)
Useful gains  409.4361   455.2625   496.5110   529.1454   515.5700   414.1427   293.1747   301.9337   391.8062   409.3470   392.9315   390.1510 (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
             1268.2499  1226.5245  1108.5815   922.2894   709.0188   472.9683   307.0413   322.7279   508.7335   775.8970  1039.5011  1262.2855 (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
              638.9575   518.2881   455.3804   283.0637   143.9259     0.0000     0.0000     0.0000     0.0000   272.7132   465.5301   648.8681 (98)
Space heating                                                                                                                         3426.7270 (98)
Space heating per m2                                                                                                 (98) / (4) =      48.2366 (99)


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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3778.0893	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	638.9575	518.2881	455.3804	283.0637	143.9259	0.0000	0.0000	0.0000	0.0000	272.7132	465.5301	648.8681	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	704.4735	571.4311	502.0732	312.0878	158.6835	0.0000	0.0000	0.0000	0.0000	300.6761	513.2636	715.4003	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9446	89.8961	89.7849	89.5252	88.9800	87.2000	87.2000	87.2000	87.2000	89.4667	89.8098	89.9696	(217)
Fuel for water heating, kWh/month													
	187.9691	165.2675	172.6243	153.5920	150.2664	135.2999	128.3251	143.0511	143.5078	159.4607	169.9770	182.8613	(219)
Water heating fuel used												1892.2022	(219)
Annual totals kWh/year													
Space heating fuel - main system												3778.0893	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												5381.7197	(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	3778.0893	0.2160	816.0673	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1892.2022	0.2160	408.7157	(264)
Space and water heating			1224.7830	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-699.8470	0.5190	-363.2206	(269)
Total CO2, kg/year			1075.0142	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1300	(273)

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

DER		15.1300	ZC1
Total Floor Area	TFA	71.0400	
Assumed number of occupants	N	2.2711	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6589	ZC2
CO2 emissions from cooking, equation (L16)		2.4424	ZC3
Total CO2 emissions		34.2313	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		34.2313	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	35.5200 (1b)	x	2.3900 (2b)	=	84.8928	(1b) - (3b)
First floor	35.5200 (1c)	x	2.6100 (2c)	=	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			10.0900	1.3258	13.3769			(27)
Ground Floor			35.5200	0.1300	4.6176			(28a)
Brick and Block	84.0000	12.2400	71.7600	0.1800	12.9168			(29a)
External Roof 1	35.5200		35.5200	0.1300	4.6176			(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.6789			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.6979	(36)
Total fabric heat loss					(33) + (36) =		46.3768	(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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	81.7209	81.4864	81.2565	80.1766	79.9746	79.0341	79.0341	78.8599	79.3964	79.9746	80.3833	80.8106	(39)
Average = Sum(39)m / 12 =												80.1757	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1504	1.1470	1.1438	1.1286	1.1258	1.1125	1.1125	1.1101	1.1176	1.1258	1.1315	1.1375	(40)
HLP (average)												1.1286	(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	2.2711	(42)
Average daily hot water use (litres/day)	88.1388	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862	(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	49.4060	43.0021	45.8128	42.5964	42.2197	39.1191	40.4231	42.2197	42.5964	45.8128	46.0736	49.4060	(61)
Total heat required for water heating calculated for each month													
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473	(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													
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473	(64)
								Total per year (kWh/year) = Sum(64)m =				1915.4540	(64)
Heat gains from water heating, kWh/month													
	60.1577	52.5621	54.5990	48.2647	46.6480	40.9253	38.9667	43.6733	44.1630	50.5104	54.1524	58.6492	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	80.8571	78.2174	73.3858	67.0343	62.6989	56.8407	52.3746	58.7006	61.3375	67.8903	75.2116	78.8296	(72)
Total internal gains													
	359.6771	356.9808	343.7685	322.9579	301.9592	281.6986	268.9499	275.3325	286.3500	307.3619	331.3465	349.3670	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	421.6792	470.1527	518.6943	573.3548	613.1439	604.1452	574.1996	533.1661	487.0857	437.8548	406.9874	401.5371	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.3681	60.5418	60.7131	61.5308	61.6863	62.4203	62.4203	62.5582	62.1355	61.6863	61.3726	61.0481	
alpha	5.0245	5.0361	5.0475	5.1021	5.1124	5.1614	5.1614	5.1705	5.1424	5.1124	5.0915	5.0699	
util living area													
	0.9981	0.9963	0.9910	0.9709	0.9056	0.7554	0.5868	0.6476	0.8822	0.9818	0.9963	0.9985	(86)
MIT	19.7523	19.8843	20.1210	20.4512	20.7497	20.9342	20.9856	20.9768	20.8429	20.4664	20.0557	19.7324	(87)
Th 2	19.9599	19.9626	19.9652	19.9775	19.9798	19.9906	19.9906	19.9926	19.9865	19.9798	19.9752	19.9703	(88)
util rest of house													
	0.9975	0.9951	0.9877	0.9592	0.8668	0.6664	0.4618	0.5217	0.8194	0.9724	0.9947	0.9980	(89)
MIT 2	18.2965	18.4911	18.8374	19.3201	19.7256	19.9449	19.9851	19.9826	19.8535	19.3490	18.7510	18.2748	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.6604	18.8394	19.1583	19.6029	19.9817	20.1922	20.2352	20.2311	20.1009	19.6283	19.0772	18.6392	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6604	18.8394	19.1583	19.6029	19.9817	20.1922	20.2352	20.2311	20.1009	19.6283	19.0772	18.6392	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9931	0.9841	0.9536	0.8669	0.6858	0.4933	0.5532	0.8278	0.9680	0.9928	0.9971	(94)
Useful gains	420.0978	466.8941	510.4459	546.7704	531.5250	414.3059	283.2242	294.9631	403.2165	423.8360	404.0406	400.3556	(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													
	1173.5488	1135.8692	1028.5667	858.1208	662.3217	441.9778	287.3078	302.1210	476.4482	722.0382	962.7655	1166.8398	(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													
	560.5675	449.5513	385.4819	224.1723	97.3127	0.0000	0.0000	0.0000	0.0000	221.8624	402.2819	570.2642	(98)
Space heating												2911.4942	(98)
Space heating per m2											(98) / (4) =	40.9839	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3117.2315	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	560.5675	449.5513	385.4819	224.1723	97.3127	0.0000	0.0000	0.0000	0.0000	221.8624	402.2819	570.2642	(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)													
	600.1794	481.3183	412.7215	240.0131	104.1892	0.0000	0.0000	0.0000	0.0000	237.5400	430.7087	610.5613	(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													
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5768	87.3997	86.9766	85.9676	83.9805	80.3000	80.3000	80.3000	80.3000	85.8236	87.0887	87.6593	(217)
Fuel for water heating, kWh/month													
	220.5880	193.0798	201.8644	181.1448	179.5300	165.3673	158.4345	176.6173	178.5679	190.2484	200.1363	215.2052	(219)
Water heating fuel used												2260.7839	(219)
Annual totals kWh/year													
Space heating fuel - main system												3117.2315	(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)												336.2752	(232)
Total delivered energy for all uses												5789.2905	(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	3117.2315	0.2160	673.3220	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2260.7839	0.2160	488.3293	(264)
Space and water heating			1161.6513	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Total CO2, kg/m2/year			1375.1031	(272)
Emissions per m2 for space and water heating			16.3521	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4567	(272b)
Emissions per m2 for pumps and fans			0.5479	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3521 * 1.00) + 2.4567 + 0.5479, rounded to 2 d.p.			19.3600	(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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			9.0000	319.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12957.0692	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	182.3912	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.7503	(36)
Total fabric heat loss	(33) + (36) = 53.7055	(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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	89.0496	88.8151	88.5852	87.5053	87.3033	86.3628	86.3628	86.1886	86.7251	87.3033	87.7120	88.1393	(39)
Average = Sum(39)m / 12 =												87.5044	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2502	1.2470	1.2318	1.2289	1.2157	1.2157	1.2132	1.2208	1.2289	1.2347	1.2407	(40)
HLP (average)												1.2318	(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	2.2711 (42)
Average daily hot water use (litres/day)	88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	30.5528	26.7217	27.5744	24.0400	23.0670	19.9050	18.4450	21.1659	21.4186	24.9614	27.2473	29.5888 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)

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

	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)

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

	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)

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

	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)

Water heating gains (Table 5)

	41.0656	39.7644	37.0624	33.3889	31.0040	27.6459	24.7916	28.4487	29.7481	33.5502	37.8434	39.7699	(72)

Total internal gains

	316.8856	315.5278	304.4451	286.3126	267.2644	249.5038	238.3669	242.0806	251.7606	270.0218	290.9783	307.3072	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	378.8877	428.6997	479.3708	536.7095	578.4490	571.9504	543.6166	499.9142	452.4964	400.5147	366.6192	359.4773	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.4178	40.5245	40.6297	41.1310	41.2262	41.6752	41.6752	41.7594	41.5011	41.2262	41.0341	40.8352	
alpha	3.6945	3.7016	3.7086	3.7421	3.7484	3.7783	3.7783	3.7840	3.7667	3.7484	3.7356	3.7223	
util living area	0.9952	0.9919	0.9836	0.9596	0.8992	0.7770	0.6326	0.6912	0.8844	0.9735	0.9921	0.9961	(86)
MIT	19.1772	19.3489	19.6630	20.1026	20.5181	20.8206	20.9402	20.9156	20.6721	20.1445	19.5892	19.1511	(87)
Th 2	19.8774	19.8800	19.8826	19.8947	19.8969	19.9075	19.9075	19.9094	19.9034	19.8969	19.8924	19.8876	(88)
util rest of house	0.9940	0.9897	0.9790	0.9469	0.8642	0.6958	0.5025	0.5658	0.8301	0.9628	0.9896	0.9951	(89)
MIT 2	18.2180	18.3909	18.7048	19.1456	19.5407	19.8074	19.8868	19.8769	19.6921	19.1934	18.6403	18.1995	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.4578	18.6304	18.9443	19.3849	19.7851	20.0607	20.1501	20.1366	19.9371	19.4312	18.8775	18.4374	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4578	18.6304	18.9443	19.3849	19.7851	20.0607	20.1501	20.1366	19.9371	19.4312	18.8775	18.4374	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9917	0.9864	0.9737	0.9394	0.8600	0.7087	0.5338	0.5948	0.8321	0.9568	0.9864	0.9932	(94)
Useful gains	375.7555	422.8568	466.7741	504.1996	497.4727	405.3157	290.1790	297.3339	376.5190	383.2173	361.6483	357.0266	(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	1260.7431	1219.4659	1102.3829	917.4831	705.8556	471.6014	306.5999	322.0513	506.2247	770.9924	1033.0290	1254.8762	(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	658.4308	535.3213	472.8929	297.5641	155.0368	0.0000	0.0000	0.0000	0.0000	288.5046	483.3941	668.0001	(98)
Space heating												3559.1448	(98)
Space heating per m2											(98) / (4) =	50.1006	(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	811.8102	639.0847	655.0335	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7603	0.8344	0.7993	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	617.1796	533.2588	523.5638	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	753.4289	718.6454	669.1104	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	98.0995	137.9276	108.2867	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												344.3137 (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	24.5249	34.4819	27.0717	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												86.0784 (107)
Space cooling per m2												1.2117 (108)
Energy for space heating												50.1006 (99)
Energy for space cooling												1.2117 (108)
Total												51.3123 (109)
Dwelling Fabric Energy Efficiency (DFEE)												51.3 (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	35.5200 (1b)	x	2.3900 (2b)	=	84.8928	(1b) - (3b)
First floor	35.5200 (1c)	x	2.6100 (2c)	=	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			10.0900	1.3258	13.3769			(27)
Ground Floor			35.5200	0.1300	4.6176			(28a)
Brick and Block	84.0000	12.2400	71.7600	0.1800	12.9168			(29a)
External Roof 1	35.5200		35.5200	0.1300	4.6176			(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.6789			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.6979	(36)
Total fabric heat loss					(33) + (36) =		46.3768	(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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	81.7209	81.4864	81.2565	80.1766	79.9746	79.0341	79.0341	78.8599	79.3964	79.9746	80.3833	80.8106	(39)
Average = Sum(39)m / 12 =												80.1757	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1504	1.1470	1.1438	1.1286	1.1258	1.1125	1.1125	1.1101	1.1176	1.1258	1.1315	1.1375	(40)
HLP (average)												1.1286	(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	2.2711	(42)
Average daily hot water use (litres/day)	88.1388	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(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													
	30.5528	26.7217	27.5744	24.0400	23.0670	19.9050	18.4450	21.1659	21.4186	24.9614	27.2473	29.5888	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	41.0656	39.7644	37.0624	33.3889	31.0040	27.6459	24.7916	28.4487	29.7481	33.5502	37.8434	39.7699	(72)
Total internal gains													
	316.8856	315.5278	304.4451	286.3126	267.2644	249.5038	238.3669	242.0806	251.7606	270.0218	290.9783	307.3072	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	378.8877	428.6997	479.3708	536.7095	578.4490	571.9504	543.6166	499.9142	452.4964	400.5147	366.6192	359.4773	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.3681	60.5418	60.7131	61.5308	61.6863	62.4203	62.4203	62.5582	62.1355	61.6863	61.3726	61.0481	
alpha	5.0245	5.0361	5.0475	5.1021	5.1124	5.1614	5.1614	5.1705	5.1424	5.1124	5.0915	5.0699	
util living area													
	0.9988	0.9976	0.9936	0.9776	0.9217	0.7822	0.6152	0.6816	0.9058	0.9875	0.9977	0.9991	(86)
MIT	19.6962	19.8304	20.0710	20.4088	20.7203	20.9222	20.9822	20.9707	20.8165	20.4207	20.0031	19.6770	(87)
Th 2	19.9599	19.9626	19.9652	19.9775	19.9798	19.9906	19.9906	19.9926	19.9865	19.9798	19.9752	19.9703	(88)
util rest of house													
	0.9984	0.9967	0.9912	0.9682	0.8873	0.6952	0.4864	0.5533	0.8504	0.9807	0.9967	0.9988	(89)
MIT 2	18.7683	18.9043	19.1460	19.4885	19.7821	19.9528	19.9859	19.9837	19.8767	19.5053	19.0871	18.7574	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	19.0003	19.1358	19.3773	19.7186	20.0167	20.1952	20.2350	20.2304	20.1116	19.7342	19.3161	18.9873	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0003	19.1358	19.3773	19.7186	20.0167	20.1952	20.2350	20.2304	20.1116	19.7342	19.3161	18.9873	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9958	0.9894	0.9652	0.8888	0.7147	0.5190	0.5857	0.8587	0.9785	0.9958	0.9984	(94)
Useful gains	378.1001	426.8980	474.2742	518.0404	514.1352	408.7701	282.1465	292.8180	388.5535	391.9185	365.0925	358.9076	(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													
	1201.3182	1160.0240	1046.3602	867.3953	665.1228	442.2094	287.2852	302.0672	477.3023	730.5025	981.9671	1194.9730	(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													
	612.4743	492.6607	425.6320	251.5356	112.3347	0.0000	0.0000	0.0000	0.0000	251.9065	444.1497	622.0327	(98)
Space heating												3212.7261	(98)
Space heating per m2											(98) / (4) =	45.2242	(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	742.9204	584.8523	599.3354	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8435	0.9106	0.8803	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	626.6707	532.5553	527.6231	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	753.4289	718.6454	669.1104	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	91.2659	138.4510	105.2665	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												334.9834	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Intermittency factor (Table 10b)
          0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
          0.0000    0.0000    0.0000    0.0000    0.0000   22.8165   34.6127   26.3166    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                              83.7459 (107)
Space cooling per m2                                                                                                        1.1789 (108)
Energy for space heating                                                                                                   45.2242 (99)
Energy for space cooling                                                                                                    1.1789 (108)
Total                                                                                                                      46.4030 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                        53.4 (109)


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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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.4189	(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) =	0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	89.0496	88.1393	87.9233	87.3033	87.3033	86.7251	86.7251	86.5416	86.7251	87.7120	87.5053	88.1393	(39)
Average = Sum(39)m / 12 =												87.4827	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2407	1.2377	1.2289	1.2289	1.2208	1.2208	1.2182	1.2208	1.2347	1.2318	1.2407	(40)
HLP (average)												1.2315	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (64)

Total per year (kWh/year) = Sum(64)m = 1683.4385 (64)

RHI water heating demand 1683 (64)

Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	15.0428	0.6300	0.7000	0.7700	30.3421	(75)
Southwest	3.4900	46.3896	0.6300	0.7000	0.7700	49.4786	(79)

Solar gains	79.8207	125.1263	193.7003	283.8247	337.4753	378.4267	349.6976	301.4636	236.2723	152.9940	96.6207	64.0501 (83)
Total gains	597.5752	638.6070	687.2506	746.6659	769.0555	782.0229	736.9916	696.7217	649.2605	596.8926	574.7726	567.9442 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.4150	41.8427	41.9455	42.2434	42.2434	42.5250	42.5250	42.6152	42.5250	42.0465	42.1458	41.8427	
alpha	3.7610	3.7895	3.7964	3.8162	3.8162	3.8350	3.8350	3.8410	3.8350	3.8031	3.8097	3.7895	
util living area	0.9757	0.9681	0.9453	0.8887	0.7731	0.5790	0.4251	0.4468	0.6978	0.8919	0.9582	0.9787	(86)
MIT	19.6992	19.8183	20.1014	20.4618	20.7748	20.9465	20.9876	20.9855	20.8906	20.5551	20.1052	19.6887	(87)
Th 2	19.8774	19.8876	19.8900	19.8969	19.8969	19.9034	19.9034	19.9055	19.9034	19.8924	19.8947	19.8876	(88)
util rest of house	0.9695	0.9601	0.9309	0.8588	0.7121	0.4814	0.3041	0.3207	0.6038	0.8543	0.9455	0.9731	(89)
MIT 2	18.7320	18.8562	19.1335	19.4788	19.7519	19.8804	19.9007	19.9022	19.8494	19.5685	19.1449	18.7299	(90)

Living area fraction fLA = Living area / (4) = 0.2500 (91)

MIT	18.9738	19.0967	19.3755	19.7246	20.0076	20.1470	20.1724	20.1730	20.1097	19.8151	19.3850	18.9696	(92)

Temperature adjustment 0.0000

adjusted MIT	18.9738	19.0967	19.3755	19.7246	20.0076	20.1470	20.1724	20.1730	20.1097	19.8151	19.3850	18.9696	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9630	0.9528	0.9228	0.8534	0.7189	0.5041	0.3345	0.3524	0.6231	0.8512	0.9381	0.9671	(94)
Useful gains	575.4429	608.4666	634.1633	637.2148	552.8604	394.2516	246.5219	245.5586	404.5311	508.0572	539.1955	549.2770	(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	1208.7390	1180.7743	1061.7142	883.9087	646.7112	411.6799	249.1100	248.6346	443.1366	703.0226	961.2437	1187.1987	(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	471.1723	384.5908	318.0979	177.6197	69.8250	0.0000	0.0000	0.0000	0.0000	145.0543	303.8747	474.6138	(98)

Space heating 2344.8484 (98)

RHI space heating demand 2345 (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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	89.0496	88.8151	88.5852	87.5053	87.3033	86.3628	86.3628	86.1886	86.7251	87.3033	87.7120	88.1393	(39)
Average = Sum(39)m / 12 =												87.5044	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2502	1.2470	1.2318	1.2289	1.2157	1.2157	1.2132	1.2208	1.2289	1.2347	1.2407	(40)
HLP (average)												1.2318	(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	2.2711 (42)
Average daily hot water use (litres/day)	88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862	(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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783	(61)
Total heat required for water heating calculated for each month	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(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	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Total per year (kWh/year) = Sum(64)m =												1683.4385	(64)
Heat gains from water heating, kWh/month	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173	(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	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	(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)	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222	(72)
Total internal gains	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	579.7566	626.6526	668.4760	713.2382	742.7649	726.0429	692.5437	653.0917	613.7240	574.3915	553.7928	556.0642	(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	41.4150	41.5243	41.6321	42.1458	42.2434	42.7034	42.7034	42.7897	42.5250	42.2434	42.0465	41.8427	
alpha	3.7610	3.7683	3.7755	3.8097	3.8162	3.8469	3.8469	3.8526	3.8350	3.8162	3.8031	3.7895	
util living area	0.9821	0.9744	0.9574	0.9148	0.8261	0.6745	0.5227	0.5688	0.7830	0.9281	0.9722	0.9846	(86)
MIT	19.5192	19.6770	19.9585	20.3412	20.6782	20.8975	20.9707	20.9593	20.8085	20.3918	19.8969	19.4898	(87)
Th 2	19.8774	19.8800	19.8826	19.8947	19.8969	19.9075	19.9075	19.9094	19.9034	19.8969	19.8924	19.8876	(88)
util rest of house	0.9778	0.9681	0.9464	0.8916	0.7774	0.5869	0.4043	0.4500	0.7083	0.9036	0.9643	0.9808	(89)
MIT 2	18.5538	18.7113	18.9892	19.3658	19.6727	19.8549	19.8983	19.8955	19.7919	19.4222	18.9395	18.5327	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.7951	18.9527	19.2315	19.6096	19.9241	20.1156	20.1664	20.1614	20.0460	19.6646	19.1788	18.7719	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7951	18.9527	19.2315	19.6096	19.9241	20.1156	20.1664	20.1614	20.0460	19.6646	19.1788	18.7719	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9614	0.9384	0.8845	0.7787	0.6048	0.4336	0.4790	0.7192	0.8974	0.9576	0.9758	(94)
Useful gains	563.6634	602.4869	627.2995	630.8575	578.4042	439.1412	300.2762	312.8214	441.3992	515.4357	530.3317	542.6064	(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	1290.7865	1248.0932	1127.8244	937.1504	717.9870	476.3405	308.0030	324.1921	515.6687	791.3675	1059.4594	1284.3608	(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	540.9796	433.8475	372.3905	220.5309	103.8496	0.0000	0.0000	0.0000	0.0000	205.2933	380.9720	551.8653	(98)
Space heating												2809.7288	(98)
Space heating per m2											(98) / (4) =	39.5514	(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 %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3097.8266	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	540.9796	433.8475	372.3905	220.5309	103.8496	0.0000	0.0000	0.0000	0.0000	205.2933	380.9720	551.8653	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	596.4494	478.3324	410.5739	243.1433	114.4979	0.0000	0.0000	0.0000	0.0000	226.3432	420.0352	608.4513	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8414	89.7808	89.6426	89.3231	88.6962	87.2000	87.2000	87.2000	87.2000	89.2316	89.6704	89.8716	(217)
Fuel for water heating, kWh/month													
	188.1852	165.4799	172.8984	153.9394	150.7472	135.2999	128.3251	143.0511	143.5078	159.8808	170.2413	183.0607	(219)
Water heating fuel used												1894.6168	(219)
Annual totals kWh/year													
Space heating fuel - main system												3097.8266	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												4703.8716	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3097.8266	3.4800	107.8044	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1894.6168	3.4800	65.9327	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	336.2752	13.1900	44.3547	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.8470	13.1900	-92.3098	(252)
Total energy cost			255.6744	(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] =	0.9254	(257)
SAP value		87.0907	
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	3097.8266	0.2160	669.1306	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1894.6168	0.2160	409.2372	(264)
Space and water heating			1078.3678	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-699.8470	0.5190	-363.2206	(269)
Total kg/year			928.5990	(272)
CO2 emissions per m2			13.0700	(273)
EI value			89.2768	
EI rating			89	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8874 = 3.922, stars = 4
Water heating environmental impact	0.216 / 0.8874 = 0.2434, 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4189	(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) =		0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	89.0496	88.1393	87.9233	87.3033	87.3033	86.7251	86.7251	86.5416	86.7251	87.7120	87.5053	88.1393	(39)
Average = Sum(39)m / 12 =												87.4827	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2407	1.2377	1.2289	1.2289	1.2208	1.2208	1.2182	1.2208	1.2347	1.2318	1.2407	(40)
HLP (average)												1.2315	(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	2.2711	(42)
Average daily hot water use (litres/day)	88.1388	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

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

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

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862	(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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783	(61)
Total heat required for water heating calculated for each month													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
								Total per year (kWh/year) = Sum(64)m =				1683.4385	(64)
Heat gains from water heating, kWh/month													
	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222	(72)
Total internal gains													
	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	15.0428	0.6300	0.7000	0.7700	30.3421	(75)
Southwest	3.4900	46.3896	0.6300	0.7000	0.7700	49.4786	(79)

Solar gains	79.8207	125.1263	193.7003	283.8247	337.4753	378.4267	349.6976	301.4636	236.2723	152.9940	96.6207	64.0501	(83)
Total gains	597.5752	638.6070	687.2506	746.6659	769.0555	782.0229	736.9916	696.7217	649.2605	596.8926	574.7726	567.9442	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.4150	41.8427	41.9455	42.2434	42.2434	42.5250	42.5250	42.6152	42.5250	42.0465	42.1458	41.8427	
alpha	3.7610	3.7895	3.7964	3.8162	3.8162	3.8350	3.8350	3.8410	3.8350	3.8031	3.8097	3.7895	
util living area													
	0.9757	0.9681	0.9453	0.8887	0.7731	0.5790	0.4251	0.4468	0.6978	0.8919	0.9582	0.9787	(86)
MIT	19.6992	19.8183	20.1014	20.4618	20.7748	20.9465	20.9876	20.9855	20.8906	20.5551	20.1052	19.6887	(87)
Th 2	19.8774	19.8876	19.8900	19.8969	19.8969	19.9034	19.9034	19.9055	19.9034	19.8924	19.8947	19.8876	(88)
util rest of house													
	0.9695	0.9601	0.9309	0.8588	0.7121	0.4814	0.3041	0.3207	0.6038	0.8543	0.9455	0.9731	(89)
MIT 2	18.7320	18.8562	19.1335	19.4788	19.7519	19.8804	19.9007	19.9022	19.8494	19.5685	19.1449	18.7299	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.9738	19.0967	19.3755	19.7246	20.0076	20.1470	20.1724	20.1730	20.1097	19.8151	19.3850	18.9696	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9738	19.0967	19.3755	19.7246	20.0076	20.1470	20.1724	20.1730	20.1097	19.8151	19.3850	18.9696	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9630	0.9528	0.9228	0.8534	0.7189	0.5041	0.3345	0.3524	0.6231	0.8512	0.9381	0.9671	(94)
Useful gains	575.4429	608.4666	634.1633	637.2148	552.8604	394.2516	246.5219	245.5586	404.5311	508.0572	539.1955	549.2770	(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													
	1208.7390	1180.7743	1061.7142	883.9087	646.7112	411.6799	249.1100	248.6346	443.1366	703.0226	961.2437	1187.1987	(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													
	471.1723	384.5908	318.0979	177.6197	69.8250	0.0000	0.0000	0.0000	0.0000	145.0543	303.8747	474.6138	(98)
Space heating												2344.8484	(98)
Space heating per m2											(98) / (4) =	33.0074	(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 %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2585.2793	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	471.1723	384.5908	318.0979	177.6197	69.8250	0.0000	0.0000	0.0000	0.0000	145.0543	303.8747	474.6138	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	519.4844	424.0251	350.7143	195.8320	76.9845	0.0000	0.0000	0.0000	0.0000	159.9275	335.0327	523.2787	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.7487	89.6968	89.5228	89.1388	88.3699	87.2000	87.2000	87.2000	87.2000	88.9301	89.4988	89.7725	(217)
Fuel for water heating, kWh/month													
	188.3794	165.6349	173.1297	154.2577	151.3039	135.2999	128.3251	143.0511	143.5078	160.4228	170.5677	183.2628	(219)
Water heating fuel used												1897.1426	(219)
Annual totals kWh/year													
Space heating fuel - main system												2585.2793	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1182 * 1.00) =										-803.5605		-803.5605	(233)
Total delivered energy for all uses												4090.1367	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2585.2793	9.7400	251.8062	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1897.1426	9.7400	184.7817	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	336.2752	36.8500	123.9174	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-803.5605	36.8500	-296.1120	(252)
Total energy cost			396.0308	(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	2585.2793	0.2160	558.4203	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1897.1426	0.2160	409.7828	(264)
Space and water heating			968.2031	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	0.5190	-417.0479	(269)
Total kg/year			764.6071	(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	2585.2793	1.2200	3154.0408	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1897.1426	1.2200	2314.5140	(264)
Space and water heating			5468.5548	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	336.2752	3.0700	1032.3649	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	3.0700	-2466.9306	(269)
Primary energy kWh/year			4264.2391	(272)
Primary energy kWh/m2/year			60.0259	(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 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 77	-185 kg (24.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.61 kg/m²	B 88	B 91
Total Savings	£77	2.61 kg/m²		

Potential energy efficiency rating: B 88
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£152	£170	-£18
Mains gas	£541	£445	£95
Space heating	£383	£383	£0
Water heating	£185	£108	£77
Lighting	£124	£124	£0
Generated (PV)	-£296	-£296	£0
Total cost of fuels	£397	£319	£77
Total cost of uses	£396	£319	£77
Delivered energy	58 kWh/m²	45 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	8 kg/m²	3 kg/m²
Primary energy	60 kWh/m²	45 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	89.0496	88.8151	88.5852	87.5053	87.3033	86.3628	86.3628	86.1886	86.7251	87.3033	87.7120	88.1393	(39)
Average = Sum(39)m / 12 =												87.5044	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2502	1.2470	1.2318	1.2289	1.2157	1.2157	1.2132	1.2208	1.2289	1.2347	1.2407	(40)
HLP (average)												1.2318	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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	1.3078 (H8)
Utilisation factor	0.5345 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	88.1388 (H14)
Volume ratio Veff/V	0.8509 (H15)
Solar storage volume factor	0.9677 (H16)
Solar input	-824.8455 (H17)

Solar input	-23.9189	-39.9137	-67.9776	-91.1034	-112.5506	-110.6552	-109.1928	-95.4023	-74.7192	-51.0244	-28.3712	-20.0160 (63)

Solar input (sum of months) = Sum(63)m = -824.8455 (63)

Output from w/h

	145.1493	108.6554	87.0130	46.4000	21.1564	7.3263	2.7066	29.3383	50.4196	91.6397	124.2848	144.5036 (64)

Total per year (kWh/year) = Sum(64)m = 858.5929 (64)

Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701 (83)
Total gains	579.7566	626.6526	668.4760	713.2382	742.7649	726.0429	692.5437	653.0917	613.7240	574.3915	553.7928	556.0642 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.4150	41.5243	41.6321	42.1458	42.2434	42.7034	42.7034	42.7897	42.5250	42.2434	42.0465	41.8427	
alpha	3.7610	3.7683	3.7755	3.8097	3.8162	3.8469	3.8469	3.8526	3.8350	3.8162	3.8031	3.7895	
util living area	0.9821	0.9744	0.9574	0.9148	0.8261	0.6745	0.5227	0.5688	0.7830	0.9281	0.9722	0.9846	(86)
MIT	19.5192	19.6770	19.9585	20.3412	20.6782	20.8975	20.9707	20.9593	20.8085	20.3918	19.8969	19.4898	(87)
Th 2	19.8774	19.8800	19.8826	19.8947	19.8969	19.9075	19.9075	19.9094	19.9034	19.8969	19.8924	19.8876	(88)
util rest of house	0.9778	0.9681	0.9464	0.8916	0.7774	0.5869	0.4043	0.4500	0.7083	0.9036	0.9643	0.9808	(89)
MIT 2	18.5538	18.7113	18.9892	19.3658	19.6727	19.8549	19.8983	19.8955	19.7919	19.4222	18.9395	18.5327	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.7951	18.9527	19.2315	19.6096	19.9241	20.1156	20.1664	20.1614	20.0460	19.6646	19.1788	18.7719	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7951	18.9527	19.2315	19.6096	19.9241	20.1156	20.1664	20.1614	20.0460	19.6646	19.1788	18.7719	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9722	0.9614	0.9384	0.8845	0.7787	0.6048	0.4336	0.4790	0.7192	0.8974	0.9576	0.9758	(94)
Useful gains	563.6634	602.4869	627.2995	630.8575	578.4042	439.1412	300.2762	312.8214	441.3992	515.4357	530.3317	542.6064	(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	1290.7865	1248.0932	1127.8244	937.1504	717.9870	476.3405	308.0030	324.1921	515.6687	791.3675	1059.4594	1284.3608	(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	540.9796	433.8475	372.3905	220.5309	103.8496	0.0000	0.0000	0.0000	0.0000	205.2933	380.9720	551.8653	(98)
Space heating												2809.7288	(98)
Space heating per m2											(98) / (4) =	39.5514	(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 %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3097.8266	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	540.9796	433.8475	372.3905	220.5309	103.8496	0.0000	0.0000	0.0000	0.0000	205.2933	380.9720	551.8653	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	596.4494	478.3324	410.5739	243.1433	114.4979	0.0000	0.0000	0.0000	0.0000	226.3432	420.0352	608.4513	(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	145.1493	108.6554	87.0130	46.4000	21.1564	7.3263	2.7066	29.3383	50.4196	91.6397	124.2848	144.5036	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9363	89.9767	90.0157	90.0716	90.0880	87.2000	87.2000	87.2000	87.2000	89.5902	89.8133	89.9508	(217)
Fuel for water heating, kWh/month	161.3911	120.7595	96.6642	51.5146	23.4842	8.4018	3.1039	33.6448	57.8206	102.2876	138.3813	160.6473	(219)
Water heating fuel used												958.1010	(219)
Annual totals kWh/year													
Space heating fuel - main system												3097.8266	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												3817.3559	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3097.8266	3.4800	107.8044	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	958.1010	3.4800	33.3419	(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	336.2752	13.1900	44.3547	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.8470	13.1900	-92.3098	(252)
Total energy cost			229.6787	(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] =	0.8313	(257)
SAP value	88.4032	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - main system 1	3097.8266	0.2160	669.1306 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	958.1010	0.2160	206.9498 (264)
Space and water heating			876.0804 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	336.2752	0.5190	174.5268 (268)
Energy saving/generation technologies			
PV Unit	-699.8470	0.5190	-363.2206 (269)
Total kg/year			752.2616 (272)
CO2 emissions per m2			10.5900 (273)
EI value			91.3131
EI rating			91 (274)
EI band			B

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

SAP 2012 WORKSHEET FOR New Build (As 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	84.0000	12.2400	71.7600	0.2400	17.2224	42.2200	3029.7072	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			155.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.9552			(33)
Party Wall 1			38.9500	0.0000	0.0000	110.0000	4284.5000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13276.7492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		186.8912 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7503 (36)
Total fabric heat loss	(33) + (36) =	53.7055 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	89.0496	88.1393	87.9233	87.3033	87.3033	86.7251	86.7251	86.5416	86.7251	87.7120	87.5053	88.1393	(39)
Average = Sum(39)m / 12 =												87.4827	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2535	1.2407	1.2377	1.2289	1.2289	1.2208	1.2208	1.2182	1.2208	1.2347	1.2318	1.2407	(40)
HLP (average)												1.2315	(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	2.2711 (42)
Average daily hot water use (litres/day)	88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)

```
Distribution loss  (46)m = 0.15 x (45)m
               21.5667    18.8624    19.4643    16.9694    16.2826    14.0506    13.0200    14.9406    15.1190    17.6198    19.2334    20.8862 (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     25.2901    22.8200    25.2287    24.3739    25.1566    24.3107    25.0997    25.1366    24.3452    25.1989    24.4335    25.2783 (61)
Total heat required for water heating calculated for each month
              169.0681   148.5691   154.9906   137.5035   133.7071   117.9815   111.8995   124.7406   125.1388   142.6641   152.6560   164.5196 (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                                                                                                                    1.4955 (H8)
Utilisation factor                                                                                                                     0.4876 (H9)
Collector performance factor                                                                                                           0.8793 (H10)
Dedicated solar storage volume                                                                                                        75.0000 (H11)
Effective solar volume                                                                                                                75.0000 (H13)
Daily hot water demand                                                                                                                88.1388 (H14)
Volume ratio Veff/V                                                                                                                    0.8509 (H15)
Solar storage volume factor                                                                                                            0.9677 (H16)
Solar input                                                                                                                         -860.4878 (H17)
Solar input    -28.2384   -40.3112   -68.3206   -93.2277  -110.0290  -117.0917  -112.7687  -100.6045   -79.6226   -54.5174   -33.1999   -22.5562 (63)
                                                                                     Solar input (sum of months) = Sum(63)m =       -860.4878 (63)
Output from w/h
              140.8297   108.2579    86.6700    44.2758    23.6781     0.8899     0.0000    24.1361    45.5162    88.1467   119.4561   141.9634 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =        823.8199 (64)
Heat gains from water heating, kWh/month
               54.1287    47.5166    49.4530    43.7091    42.3822    37.2232    35.1358    39.4025    39.6002    45.3569    48.7424    52.6173 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               47.6032    42.2808    34.3850    26.0317    19.4590    16.4281    17.7511    23.0736    30.9693    39.3227    45.8954    48.9263 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              298.0777   301.1708   293.3763   276.7826   255.8361   236.1493   222.9973   219.9042   227.6988   244.2924   265.2390   284.9257 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977 (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)
              -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443 (71)
Water heating gains (Table 5)
               72.7537    70.7092    66.4691    60.7070    56.9653    51.6989    47.2256    52.9603    55.0002    60.9636    67.6977    70.7222 (72)
Total internal gains
              517.7545   513.4807   493.5503   462.8412   431.5803   403.5962   387.2939   395.2580   412.9882   443.8986   478.1519   503.8941 (73)


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6. Solar gains
-----------------------------------------------------------------------------------------------------
[Jan]                                         Area          Solar flux                g                FF             Access             Gains
                                                m2            Table 6a    Specific data    Specific data             factor                 W
                                                                  W/m2      or Table 6b      or Table 6c           Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                   6.6000             15.0428           0.6300           0.7000             0.7700           30.3421 (75)
Southwest                                   3.4900             46.3896           0.6300           0.7000             0.7700           49.4786 (79)
-----------------------------------------------------------------------------------------------------

Solar gains     79.8207   125.1263   193.7003   283.8247   337.4753   378.4267   349.6976   301.4636   236.2723   152.9940    96.6207    64.0501 (83)
Total gains    597.5752   638.6070   687.2506   746.6659   769.0555   782.0229   736.9916   696.7217   649.2605   596.8926   574.7726   567.9442 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                           21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            41.4150    41.8427    41.9455    42.2434    42.2434    42.5250    42.5250    42.6152    42.5250    42.0465    42.1458    41.8427
alpha           3.7610     3.7895     3.7964     3.8162     3.8162     3.8350     3.8350     3.8410     3.8350     3.8031     3.8097     3.7895
util living area
                0.9757     0.9681     0.9453     0.8887     0.7731     0.5790     0.4251     0.4468     0.6978     0.8919     0.9582     0.9787 (86)

MIT            19.6992    19.8183    20.1014    20.4618    20.7748    20.9465    20.9876    20.9855    20.8906    20.5551    20.1052    19.6887 (87)
Th 2           19.8774    19.8876    19.8900    19.8969    19.8969    19.9034    19.9034    19.9055    19.9034    19.8924    19.8947    19.8876 (88)
util rest of house
                0.9695     0.9601     0.9309     0.8588     0.7121     0.4814     0.3041     0.3207     0.6038     0.8543     0.9455     0.9731 (89)
MIT 2          18.7320    18.8562    19.1335    19.4788    19.7519    19.8804    19.9007    19.9022    19.8494    19.5685    19.1449    18.7299 (90)
Living area fraction                                                                       fLA = Living area / (4) =           0.2500 (91)
MIT            18.9738    19.0967    19.3755    19.7246    20.0076    20.1470    20.1724    20.1730    20.1097    19.8151    19.3850    18.9696 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT   18.9738    19.0967    19.3755    19.7246    20.0076    20.1470    20.1724    20.1730    20.1097    19.8151    19.3850    18.9696 (93)


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

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	
Utilisation	0.9630	0.9528	0.9228	0.8534	0.7189	0.5041	0.3345	0.3524	0.6231	0.8512	0.9381	0.9671	(94)
Useful gains	575.4429	608.4666	634.1633	637.2148	552.8604	394.2516	246.5219	245.5586	404.5311	508.0572	539.1955	549.2770	(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	1208.7390	1180.7743	1061.7142	883.9087	646.7112	411.6799	249.1100	248.6346	443.1366	703.0226	961.2437	1187.1987	(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	471.1723	384.5908	318.0979	177.6197	69.8250	0.0000	0.0000	0.0000	0.0000	145.0543	303.8747	474.6138	(98)
Space heating												2344.8484	(98)
Space heating per m2											(98) / (4) =	33.0074	(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 %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2585.2793	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	471.1723	384.5908	318.0979	177.6197	69.8250	0.0000	0.0000	0.0000	0.0000	145.0543	303.8747	474.6138	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	519.4844	424.0251	350.7143	195.8320	76.9845	0.0000	0.0000	0.0000	0.0000	159.9275	335.0327	523.2787	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	140.8297	108.2579	86.6700	44.2758	23.6781	0.8899	0.0000	24.1361	45.5162	88.1467	119.4561	141.9634	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8699	89.9073	89.9271	89.9794	89.7874	87.2000	87.2000	87.2000	87.2000	89.3445	89.6842	89.8695	(217)
Fuel for water heating, kWh/month	156.7039	120.4106	96.3781	49.2066	26.3713	1.0205	0.0000	27.6790	52.1974	98.6594	133.1964	157.9662	(219)
Water heating fuel used												919.7893	(219)
Annual totals kWh/year													
Space heating fuel - main system												2585.2793	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1182 * 1.00) =										-803.5605		-803.5605	(233)
Total delivered energy for all uses												3162.7834	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2585.2793	9.7400	251.8062	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	919.7893	9.7400	89.5875	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	336.2752	36.8500	123.9174	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-803.5605	36.8500	-296.1120	(252)
Total energy cost			319.2616	(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	2585.2793	0.2160	558.4203	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	919.7893	0.2160	198.6745	(264)
Space and water heating			757.0948	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	0.5190	-417.0479	(269)
Total kg/year			579.4488	(272)

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

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	2585.2793	1.2200	3154.0408	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	919.7893	1.2200	1122.1429	(264)
Space and water heating			4276.1837	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	336.2752	3.0700	1032.3649	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	3.0700	-2466.9306	(269)
Primary energy kWh/year			3225.3680	(272)
Primary energy kWh/m2/year			45.4021	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 67	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Project	Plot 67		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.13	**TER**	19.36
Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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	**Earthwool Loft Roll 40**						
	Main construction	150	0.0400	3.7500	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**Earthwool Loft Roll 40**						
	Main construction	200	0.0400	5.0000	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Earthwool Loft Roll 40**						
	Main construction	100	0.0400	2.5000	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance: **Upper limit =** 11.200 m² K/W **Lower limit =** 10.901 m² K/W **Average =** 11.050 m² K/W

Total correction = 0.0065 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 0879 Plot 67	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Project	Plot 67		
Calculation Type	New Build (As Designed)		

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Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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

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Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Project	Plot 67		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.13	**TER**	19.36
Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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 000008

Floor Type: Suspended Floor
Area = 42.22 m², Perimeter = 18.37 m, Wall thickness = 300.00 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 0879 Plot 67	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V1 (HA-SO)
Property	Plot 67		

SAP Rating	87 B	**DER**	15.13	**TER**	19.36
Environmental	89 B	**% DER<TER**	21.84		
CO_2 Emissions (t/year)	0.76	**DFEE**	51.31	**TFEE**	53.36
General Requirements Compliance	Pass	**% DFEE<TFEE**	3.84		

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 West
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	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	16.80 m	35.52 m²	2.39 m
1st Storey:	16.80 m	35.52 m²	2.61 m

7.0 Living Area	17.76	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	186.89	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	84.00	71.76

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	38.95

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
GF Timber Stud	Plasterboard on timber frame	9.00	63.11
FF Timber Stud	Plasterboard on timber frame	9.00	66.20

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Plane Roof	Other	0.10	9.10	35.52	35.52

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	35.52

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	35.52

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	35.52

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 & Fully Glazed Do	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 West							2.15	
Front Elevation	Window	[1] Brick and Block	South West	None	0.00					3.49	
Rear Elevation	Window	[1] Brick and Block	North East	None	0.00					6.60	

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

17.0 Thermal Bridging — Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	0.46	0.110	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	5.46	0.910	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.02	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.59	0.067	No	Birtley Supatherm
Independently assessed	E3 Sill	5.92	0.021	No	Knauf P5
Independently assessed	E4 Jamb	24.32	0.016	No	Knauf P6
Table K1 - Default	E5 Ground floor (normal)	16.80	0.320	No	
Independently assessed	E6 Intermediate floor within a dwelling	16.80	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	9.10	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	7.79	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	10.00	0.039	No	Knauf P23
Table K1 - Approved	E18 Party wall between dwellings	10.00	0.060	No	
Table K1 - Default	P1 Party wall - Ground floor	7.79	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	7.79	0.000	No	
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	7.79	0.069	No	Knauf P29

Y-value	0.095	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	16	
Total number of L.E.L. fittings	16	
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.	17513	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.7	
In Summer	87.2	
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	Gas/Oil, time clock	

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
0.85	South West	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£77	B 88	