PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

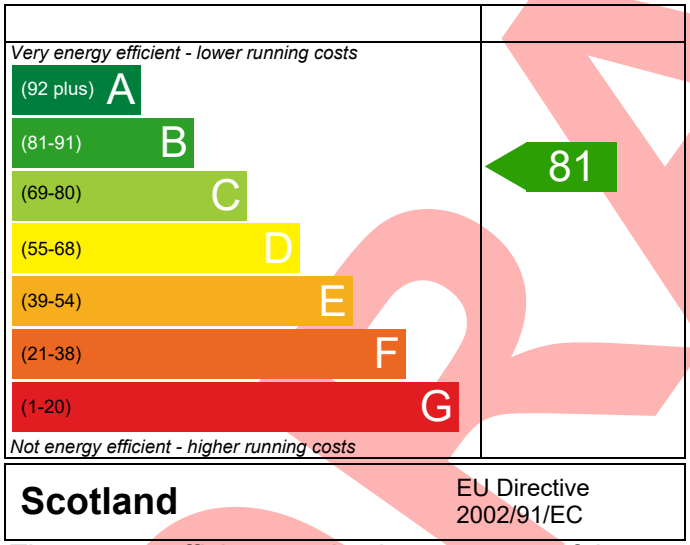
3DB 90, plot 101, Tarland Road,
Aboyne

Dwelling type:	House, Detached
Date of assessment:	23/01/2023
Produced by:	Northern Energy
Total floor area:	90.18 m²

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.

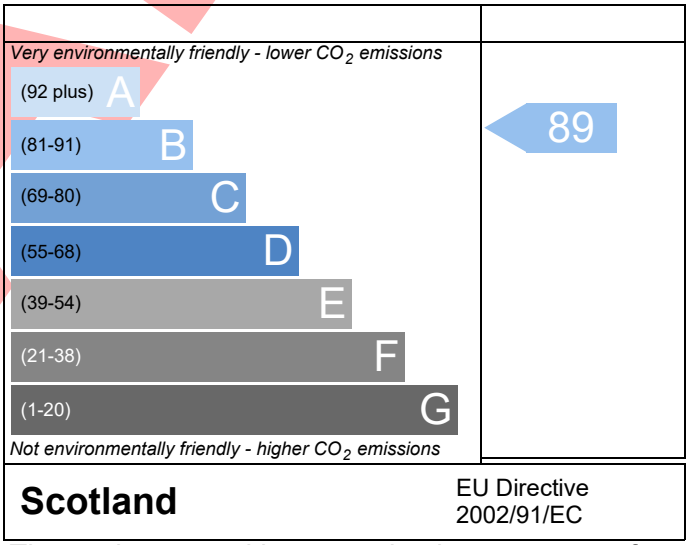
Energy Efficiency Rating



Scotland 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



Scotland 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.

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

Design SAP
elmhurst energy

Property Reference	ajc cregash 101	**Issued on Date**	23/01/2023
Assessment Reference	3db 90	**Prop Type Ref**	
Property	3DB 90, plot 101, Tarland Road, Aboyne		

SAP Rating	81 B	**DER**	13.78	**TER**	14.78
Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

6.1 Carbon Dioxide Emissions

1a TER and DER

Fuel for main heating	Bulk LPG		
Fuel package for TER	LPG		
Target Carbon Dioxide Emission Rate (TER)	14.78	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	13.78	$kgCO_2/m^2$	Pass
	-1.00 (-6.8%)	$kgCO_2/m^2$	

6.2 Building insulation envelope

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.22)	0.16 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.18)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.15)	0.10 (max. 0.35)	Pass
Openings	1.40 (max. 1.60)	1.40 (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	4.00 (design value)	

6.3 Heating System

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Bulk LPG Data from database Alpha InTec2 20SE Efficiency: 90.8% SEDBUK2009 Minimum: 88.0%	Pass
Secondary heating system	None	

6 Controls

Space heating controls	Time and temperature zone control	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass
Boiler interlock	Yes	Pass

6.4 Insulation of pipes, ducts and vessels

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 2.35 kWh/day Permitted by DBSCG 2.56	Pass
Primary pipework insulated	Yes	Pass

6.5 Artificial and display lighting

7 Low energy lights

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

6.6 Mechanical ventilation and air conditioning

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power	0.1700 0.1800	
Maximum	0.7	Pass

9 Summertime temperature

Overheating risk (North East Scotland)	Not significant	Pass

Based on:

Overshading	Average
Windows facing North	1.44 m², No overhang
Windows facing East	6.53 m², No overhang
Windows facing South	0.90 m², No overhang
Windows facing West	4.76 m², No overhang
Air change rate	2.50 ach
Blinds/curtains	None

	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	£70	B 85	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£70**	**B 85**	**B 91**	

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THERMAL BRIDGING
Calculation Type: New Build (As Designed)

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Property	3DB 90, plot 101, Tarland Road, Aboyne		

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Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Scotland ACD 2015	0.037	10.90	0.40	
External wall	E3 Sill	Scotland ACD 2015	0.033	8.40	0.28	
External wall	E4 Jamb	Scotland ACD 2015	0.031	27.90	0.86	
External wall	E5 Ground floor (normal)	Scotland ACD 2015	0.097	39.20	3.80	
External wall	E10 Eaves (insulation at ceiling level)	Scotland ACD 2015	0.043	9.30	0.40	
External wall	E12 Gable (insulation at ceiling level)	Scotland ACD 2015	0.051	29.90	1.52	
External wall	E16 Corner (normal)	Scotland ACD 2015	0.038	14.52	0.55	
External wall	E17 Corner (inverted – internal area greater than external area)	Scotland ACD 2015	-0.029	4.84	-0.14	

Total: 7.68 **W/mK:**

Y-Value: 0.033 **W/m²K:**

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

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CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
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REGULATIONS COMPLIANCE REPORT - Domestic Handbook Section 6, 2015 Edition

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REGULATIONS COMPLIANCE REPORT - Domestic Handbook Section 6, 2015 Edition
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Detached House, total floor area 90 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1 TER and DER
Fuel for main heating:Bulk LPG
Fuel package for TER:LPG
Target Carbon Dioxide Emission Rate (TER) 14.78 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.78 kgCO□/m²OK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.22)	0.16 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.18)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.15)	0.10 (max. 0.35)	OK
Openings	1.40 (max. 1.60)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
---
3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Bulk LPG
Data from database
Alpha InTec2 20SE

Efficiency: 90.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None
---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 2.35 kWh/day
Permitted by DBSCG 2.56 OK
Primary pipework insulated: Yes OK
---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK
---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum: 75% OK
---
8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1700 0.1800
Maximum: 0.7 OK
---
9 Summertime temperature
Overheating risk (North East Scotland): Not significant OK
Based on:
Overshading: Average
Windows facing North: 1.44 m², No overhang
Windows facing East: 6.53 m², No overhang
Windows facing South: 0.90 m², No overhang
Windows facing West: 4.76 m², No overhang
Air change rate: 2.50 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
Thermal bridging y-value: 0.033 W/m²K
Photovoltaic array: 1.01 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	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(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	0.3335	0.3269	0.3204	0.2877	0.2812	0.2485	0.2485	0.2419	0.2615	0.2812	0.2942	0.3073	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5835	0.5769	0.5704	0.5377	0.5312	0.5000	0.5000	0.5000	0.5115	0.5312	0.5442	0.5573	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0194	41.5485	41.0776	38.7232	38.2523	36.0089	36.0089	36.0089	36.8397	38.2523	39.1941	40.1359	(38)
Heat transfer coeff	98.2843	97.8134	97.3425	94.9881	94.5172	92.2737	92.2737	92.2737	93.1046	94.5172	95.4590	96.4007	(39)
Average = Sum(39)m / 12 =												94.9373	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0899	1.0846	1.0794	1.0533	1.0481	1.0232	1.0232	1.0232	1.0324	1.0481	1.0585	1.0690	(40)
HLP (average)												1.0528	(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		2.6282 (42)
Average daily hot water use (litres/day)		101.7044 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	228.5086	201.6467	212.3352	191.1235	187.8591	168.6699	162.7607	177.5357	176.8890	198.1459	208.5395	223.2736	(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)
FGHRS	-31.6389	-27.5711	-27.9608	-24.1079	-18.4862	-10.4035	-10.0411	-10.9497	-10.9090	-24.7810	-27.7161	-31.0026	eq.(G6)
Output from w/h													
	196.8696	174.0756	184.3744	167.0157	169.3729	158.2664	152.7196	166.5859	165.9800	173.3649	180.8234	192.2711	(64)
									Total per year (kWh/year) = Sum(64)m =			2081.7195	(64)
Heat gains from water heating, kWh/month													
	105.2453	93.4815	99.8676	91.8707	91.7293	84.4048	83.3841	88.2968	87.1377	95.1497	97.6615	103.5046	(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	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5263	20.0077	16.2714	12.3185	9.2082	7.7739	8.4000	10.9187	14.6550	18.6079	21.7182	23.1524	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	239.4085	241.8928	235.6324	222.3048	205.4811	189.6692	179.1058	176.6215	182.8819	196.2095	213.0332	228.8452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	141.4587	139.1093	134.2306	127.5981	123.2921	117.2289	112.0754	118.6785	121.0245	127.8894	135.6409	139.1191	(72)
Total internal gains													
	468.8162	466.4325	451.5571	427.6441	403.4040	380.0947	365.0039	371.6413	383.9841	408.1294	435.8150	456.5394	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	6.5300	19.6403	0.6300	0.7000	0.7700	39.1951	(76)
South	0.9000	46.7521	0.6300	0.7000	0.7700	12.8592	(78)
West	4.7600	19.6403	0.6300	0.7000	0.7700	28.5710	(80)

Solar gains	85.3050	162.5681	260.3388	373.1296	454.6884	465.0577	442.8665	381.5915	300.2048	190.6603	105.5119	70.7403	(83)
Total gains	554.1212	629.0005	711.8958	800.7737	858.0924	845.1524	807.8704	753.2328	684.1889	598.7897	541.3269	527.2797	(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	25.4873	25.6100	25.7339	26.3717	26.5031	27.1475	27.1475	27.1475	26.9052	26.5031	26.2416	25.9853	
alpha	2.6992	2.7073	2.7156	2.7581	2.7669	2.8098	2.8098	2.8098	2.7937	2.7669	2.7494	2.7324	
util living area													
	0.9640	0.9482	0.9162	0.8493	0.7433	0.5955	0.4636	0.5082	0.7128	0.8827	0.9479	0.9681	(86)
MIT	18.7599	19.0168	19.4581	20.0381	20.5047	20.8192	20.9347	20.9137	20.6804	20.0668	19.3351	18.7393	(87)
Th 2	20.0091	20.0134	20.0177	20.0391	20.0434	20.0640	20.0640	20.0640	20.0564	20.0434	20.0348	20.0262	(88)
util rest of house													
	0.9587	0.9407	0.9036	0.8263	0.7028	0.5310	0.3775	0.4215	0.6551	0.8598	0.9390	0.9634	(89)
MIT 2	17.0081	17.3812	18.0172	18.8490	19.4854	19.8960	20.0194	20.0015	19.7346	18.9072	17.8581	16.9880	(90)
Living area fraction									fLA = Living area / (4) =			0.1796	(91)
MIT	17.3228	17.6750	18.2760	19.0626	19.6685	20.0618	20.1838	20.1654	19.9045	19.1155	18.1234	17.3026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1728	17.5250	18.1260	18.9126	19.5185	19.9118	20.0338	20.0154	19.7545	18.9655	17.9734	17.1526	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9365	0.9140	0.8717	0.7935	0.6775	0.5197	0.3745	0.4167	0.6341	0.8267	0.9125	0.9429	(94)
Useful gains	518.9198	574.8771	620.5881	635.3812	581.3832	439.2066	302.5668	313.8667	433.8145	495.0357	493.9509	497.1826	(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													
	1265.1915	1234.8939	1131.7081	951.0762	738.9818	490.1404	316.8530	333.6046	526.4627	790.6858	1037.9627	1248.6429	(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													
	555.2261	443.5313	380.2732	227.3004	117.2533	0.0000	0.0000	0.0000	0.0000	219.9637	391.6885	559.0865	(98)
Space heating												2894.3230	(98)
Space heating per m2											(98) / (4) =	32.0950	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												91.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	555.2261	443.5313	380.2732	227.3004	117.2533	0.0000	0.0000	0.0000	0.0000	219.9637	391.6885	559.0865	(98)
Space heating efficiency (main heating system 1)													
	91.8000	91.8000	91.8000	91.8000	91.8000	0.0000	0.0000	0.0000	0.0000	91.8000	91.8000	91.8000	(210)
Space heating fuel (main heating system)													
	604.8215	483.1496	414.2410	247.6039	127.7269	0.0000	0.0000	0.0000	0.0000	239.6118	426.6759	609.0267	(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													
	196.8696	174.0756	184.3744	167.0157	169.3729	158.2664	152.7196	166.5859	165.9800	173.3649	180.8234	192.2711	(64)
Efficiency of water heater												81.1000	(216)
(217)m	88.7355	88.5086	88.0085	86.9415	85.1606	81.1000	81.1000	81.1000	81.1000	86.7550	88.1276	88.8019	(217)
Fuel for water heating, kWh/month													
	221.8613	196.6764	209.4961	192.1012	198.8865	195.1497	188.3103	205.4081	204.6609	199.8328	205.1835	216.5169	(219)
Water heating fuel used												2434.0836	(219)
Annual totals kWh/year													
Space heating fuel - main system												3152.8573	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 9.4900, total flow = 42.0000, SFP = 0.2260)													
mechanical ventilation fans (SFP = 0.2260)												60.1592	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												135.1592	(231)
Electricity for lighting (calculated in Appendix L)												397.8222	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.01 * 908 * 1.00) =										-733.5462		-733.5462	(233)
Total delivered energy for all uses												5386.3761	(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	3152.8573	0.2410	759.8386	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2434.0836	0.2410	586.6142	(264)
Space and water heating			1346.4528	(265)
Pumps and fans	135.1592	0.5190	70.1476	(267)
Energy for lighting	397.8222	0.5190	206.4697	(268)
Energy saving/generation technologies				
PV Unit	-733.5462	0.5190	-380.7105	(269)
Total CO2, kg/year			1242.3596	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7800	(273)

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

DER		13.7800	ZC1
Total Floor Area	TFA	90.1800	
Assumed number of occupants	N	2.6282	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.7317	ZC2
CO2 emissions from cooking, equation (L16)		2.0190	ZC3
Total CO2 emissions		31.5307	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		31.5307	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	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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	1	+	0	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	60.0000 / (5) =	0.2749	(8)
Pressure test		Yes	
Measured/design AP50		7.0000	
Infiltration rate		0.6249	(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) =	0.5312	(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	0.6773	0.6640	0.6507	0.5843	0.5710	0.5046	0.5046	0.4914	0.5312	0.5710	0.5976	0.6242	(22b)
Effective ac	0.7293	0.7204	0.7117	0.6707	0.6630	0.6273	0.6273	0.6207	0.6411	0.6630	0.6786	0.6948	(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			1.8500	1.4000	2.5900			(26)
TER Opening Type (Uw = 1.40)			20.7000	1.3258	27.4432			(27)
Insulated slab 3DB 90			49.1000	0.1500	7.3650			(28a)
Render/ Blk T/Frame	94.8600	22.5500	72.3100	0.1700	12.2927			(29a)
Horizontal	90.1800		90.1800	0.1100	9.9198			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.6107			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	18.7312	(36)
Total fabric heat loss (33) + (36) =	78.3419	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.5260	51.8846	51.2559	48.3030	47.7506	45.1787	45.1787	44.7024	46.1693	47.7506	48.8682	50.0367	(38)
Heat transfer coeff	130.8678	130.2265	129.5978	126.6449	126.0924	123.5206	123.5206	123.0443	124.5112	126.0924	127.2101	128.3785	(39)
Average = Sum(39)m / 12 =												126.6423	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4512	1.4441	1.4371	1.4044	1.3982	1.3697	1.3697	1.3644	1.3807	1.3982	1.4106	1.4236	(40)
HLP (average)												1.4043	(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	2.6282 (42)
Average daily hot water use (litres/day)	101.7044 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)

Water storage loss:	
Store volume	150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8900 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.0206 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

```
Total storage loss
              31.6386    28.5768    31.6386    30.6180    31.6386    30.6180    31.6386    31.6386    30.6180    31.6386    30.6180    31.6386 (56)
If cylinder contains dedicated solar storage
              31.6386    28.5768    31.6386    30.6180    31.6386    30.6180    31.6386    31.6386    30.6180    31.6386    30.6180    31.6386 (57)
Primary loss  23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
             220.8082   194.6915   204.6348   183.6715   180.1587   161.2179   155.0603   169.8353   169.4370   190.4455   201.0875   215.5732 (62)
WWHRS        -39.8075   -35.0229   -35.7468   -29.4294   -27.3352   -22.5567   -19.1024   -23.1246   -23.7938   -29.4010   -34.0394   -38.4718 eq.(G10)
Total of WWHRS savings                                                                                                                -357.8317
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
             181.0006   159.6686   168.8879   154.2421   152.8235   138.6612   135.9579   146.7107   145.6431   161.0445   167.0481   177.1015 (64)
                                                                                                    Total per year (kWh/year) = Sum(64)m =   1888.7897 (64)
Heat gains from water heating, kWh/month
              99.0849    87.9173    93.7073    85.9091    85.5690    78.4432    77.2238    82.1364    81.1761    88.9894    91.6999    97.3443 (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      131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088   131.4088 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               21.3434    18.9571    15.4169    11.6716     8.7247     7.3657     7.9589    10.3453    13.8854    17.6308    20.5777    21.9366 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              239.4085   241.8928   235.6324   222.3048   205.4811   189.6692   179.1058   176.6215   182.8819   196.2095   213.0332   228.8452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409    36.1409 (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)
             -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271  -105.1271 (71)
Water heating gains (Table 5)
              133.1787   130.8293   125.9506   119.3181   115.0121   108.9489   103.7954   110.3985   112.7445   119.6094   127.3609   130.8391 (72)
Total internal gains
              459.3533   457.1018   442.4226   418.7172   394.6405   371.4065   356.2828   362.7879   374.9345   398.8723   426.3945   447.0436 (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	
East	20.7000	19.6403	0.6300	0.7000	0.7700	124.2480	(76)

```
Solar gains   124.2480   243.0555   400.2778   583.7813   715.4459   732.3861   697.2615   598.9373   465.5396   288.4058   154.9227   102.1755 (83)
Total gains   583.6013   700.1573   842.7004  1002.4985  1110.0863  1103.7926  1053.5443   961.7252   840.4741   687.2781   581.3172   549.2191 (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          19.1414    19.2357    19.3290    19.7797    19.8664    20.2800    20.2800    20.3585    20.1187    19.8664    19.6918    19.5126
alpha         2.2761     2.2824     2.2886     2.3186     2.3244     2.3520     2.3520     2.3572     2.3412     2.3244     2.3128     2.3008
util living area
               0.9632     0.9440     0.9052     0.8289     0.7181     0.5785     0.4568     0.5050     0.7084     0.8800     0.9475     0.9676 (86)

MIT          18.0878    18.4187    18.9885    19.7229    20.3150    20.7202    20.8854    20.8519    20.5161    19.7111    18.7878    18.0588 (87)
Th 2          19.7243    19.7297    19.7350    19.7600    19.7647    19.7866    19.7866    19.7907    19.7782    19.7647    19.7552    19.7453 (88)
util rest of house
               0.9571     0.9348     0.8893     0.7996     0.6680     0.4996     0.3496     0.3973     0.6381     0.8527     0.9373     0.9622 (89)
MIT 2         15.8895    16.3685    17.1866    18.2300    19.0290    19.5462    19.7185    19.6959    19.3197    18.2430    16.9210    15.8570 (90)
Living area fraction                                                                                  fLA = Living area / (4) =     0.1796 (91)
MIT           16.2844    16.7368    17.5103    18.4982    19.2600    19.7571    19.9281    19.9035    19.5346    18.5067    17.2563    16.2525 (92)
Temperature adjustment                                                                                                           -0.1500
adjusted MIT  16.1344    16.5868    17.3603    18.3482    19.1100    19.6071    19.7781    19.7535    19.3846    18.3567    17.1063    16.1025 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9295     0.9004     0.8478     0.7577     0.6370     0.4867     0.3488     0.3937     0.6113     0.8104     0.9042     0.9370 (94)
Useful gains  542.4771   630.4467   714.4140   759.6316   707.1427   537.1885   367.4907   378.5909   513.8072   556.9737   525.6151   514.6306 (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
             1548.7406  1521.9265  1407.4677  1196.5667   934.3451   618.4797   392.5641   412.6343   657.9907   978.0610  1272.9075  1528.0316 (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
              748.6601   599.0744   515.6320   314.5933   169.0386     0.0000     0.0000     0.0000     0.0000   313.2890   538.0505   753.9704 (98)
Space heating                                                                                                                   3952.3081 (98)
Space heating per m2                                                                                                 (98) / (4) =    43.8269 (99)
```

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												92.0000	(206)
Efficiency of secondary/supplementary heating system, %												60.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	748.6601	599.0744	515.6320	314.5933	169.0386	0.0000	0.0000	0.0000	0.0000	313.2890	538.0505	753.9704	(98)
Space heating efficiency (main heating system 1)													
	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)													
	732.3849	586.0510	504.4226	307.7543	165.3638	0.0000	0.0000	0.0000	0.0000	306.4783	526.3537	737.5797	(211)
Water heating requirement													
	124.7767	99.8457	85.9387	52.4322	28.1731	0.0000	0.0000	0.0000	0.0000	52.2148	89.6751	125.6617	(215)
Water heating													
Water heating requirement													
	181.0006	159.6686	168.8879	154.2421	152.8235	138.6612	135.9579	146.7107	145.6431	161.0445	167.0481	177.1015	(64)
Efficiency of water heater												79.3000	(216)
(217)m	87.8721	87.6709	87.2134	86.2063	84.5180	79.3000	79.3000	79.3000	79.3000	86.0804	87.3362	87.9296	(217)
Fuel for water heating, kWh/month													
	205.9820	182.1226	193.6492	178.9221	180.8177	174.8564	171.4475	185.0071	183.6609	187.0863	191.2700	201.4127	(219)
Water heating fuel used												2236.2345	(219)
Annual totals kWh/year													
Space heating fuel - main system												3866.3884	(211)
Space heating fuel - secondary												658.7180	(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)												376.9319	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.90 * 1029 * 1.00) =										-741.0144		-741.0144	(233)
Total delivered energy for all uses												6472.2583	(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	3866.3884	0.2410	931.7996	(261)
Space heating - secondary	658.7180	0.0190	12.5156	(263)
Water heating (other fuel)	2236.2345	0.2410	538.9325	(264)
Space and water heating			1483.2478	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	376.9319	0.5190	195.6276	(268)
Energy saving/generation technologies				
PV Unit	-741.0144	0.5190	-384.5865	(269)
Total CO2, kg/m2/year			1333.2139	(272)
Target Carbon Dioxide Emission Rate (TER) = 1333.2139 / 90.18, rounded to 2 d.p.			14.7800	(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	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(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	0.3335	0.3269	0.3204	0.2877	0.2812	0.2485	0.2485	0.2419	0.2615	0.2812	0.2942	0.3073	(22b)
Effective ac	0.5556	0.5534	0.5513	0.5414	0.5395	0.5309	0.5309	0.5293	0.5342	0.5395	0.5433	0.5472	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.0129	39.8574	39.7050	38.9892	38.8552	38.2318	38.2318	38.1163	38.4719	38.8552	39.1262	39.4094	(38)
Heat transfer coeff	96.2777	96.1223	95.9699	95.2540	95.1201	94.4967	94.4967	94.3812	94.7368	95.1201	95.3910	95.6743	(39)
Average = Sum(39)m / 12 =												95.2534	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0676	1.0659	1.0642	1.0563	1.0548	1.0479	1.0479	1.0466	1.0505	1.0548	1.0578	1.0609	(40)
HLP (average)												1.0563	(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												2.6282	(42)
Average daily hot water use (litres/day)												101.7044	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(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													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.2553	30.8345	31.8184	27.7401	26.6173	22.9687	21.2839	24.4235	24.7152	28.8032	31.4410	34.1428	(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	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	131.4088	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.5263	20.0077	16.2714	12.3185	9.2082	7.7739	8.4000	10.9187	14.6550	18.6079	21.7182	23.1524	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	239.4085	241.8928	235.6324	222.3048	205.4811	189.6692	179.1058	176.6215	182.8819	196.2095	213.0332	228.8452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	36.1409	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	47.3861	45.8847	42.7667	38.5279	35.7759	31.9009	28.6073	32.8273	34.3267	38.7140	43.6680	45.8909	(72)
Total internal gains													
	371.7436	370.2078	357.0931	335.5738	312.8878	291.7667	278.5358	282.7902	294.2863	315.9541	340.8421	360.3112	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	6.5300	19.6403	0.6300	0.7000	0.7700	39.1951	(76)
South	0.9000	46.7521	0.6300	0.7000	0.7700	12.8592	(78)
West	4.7600	19.6403	0.6300	0.7000	0.7700	28.5710	(80)

Solar gains	85.3050	162.5681	260.3388	373.1296	454.6884	465.0577	442.8665	381.5915	300.2048	190.6603	105.5119	70.7403	(83)
Total gains	457.0486	532.7759	617.4319	708.7034	767.5762	756.8244	721.4024	664.3816	594.4911	506.6143	446.3540	431.0515	(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	26.0185	26.0606	26.1019	26.2981	26.3351	26.5089	26.5089	26.5413	26.4417	26.3351	26.2603	26.1826	
alpha	2.7346	2.7374	2.7401	2.7532	2.7557	2.7673	2.7673	2.7694	2.7628	2.7557	2.7507	2.7455	
util living area													
	0.9768	0.9639	0.9370	0.8797	0.7834	0.6478	0.5156	0.5662	0.7680	0.9160	0.9662	0.9801	(86)
MIT	18.6316	18.8900	19.3399	19.9165	20.4196	20.7648	20.9100	20.8809	20.5956	19.9241	19.1691	18.5779	(87)
Th 2	20.0274	20.0288	20.0302	20.0367	20.0379	20.0436	20.0436	20.0447	20.0414	20.0379	20.0355	20.0329	(88)
util rest of house													
	0.9733	0.9585	0.9271	0.8598	0.7456	0.5821	0.4223	0.4737	0.7139	0.8981	0.9602	0.9771	(89)
MIT 2	17.8466	18.1034	18.5476	19.1123	19.5856	19.8920	20.0010	19.9846	19.7573	19.1308	18.3873	17.7973	(90)
Living area fraction										fLA = Living area / (4) =		0.1796	(91)
MIT	17.9876	18.2447	18.6900	19.2568	19.7354	20.0488	20.1643	20.1456	19.9079	19.2733	18.5278	17.9375	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9876	18.2447	18.6900	19.2568	19.7354	20.0488	20.1643	20.1456	19.9079	19.2733	18.5278	17.9375	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9632	0.9452	0.9098	0.8407	0.7322	0.5825	0.4348	0.4843	0.7052	0.8801	0.9475	0.9680	(94)
Useful gains	440.2299	503.5688	561.7206	595.7849	562.0041	440.8511	313.6811	321.7485	419.2490	445.8847	422.9242	417.2685	(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													
	1317.8137	1282.7200	1169.8689	986.5231	764.3314	514.8904	336.8119	353.5153	550.2204	825.0085	1090.1057	1314.3273	(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													
	652.9223	523.5896	452.4624	281.3314	150.5315	0.0000	0.0000	0.0000	0.0000	282.0681	480.3707	667.4118	(98)
Space heating												3490.6879	(98)
Space heating per m2											(98) / (4) =	38.7080	(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	888.2685	699.2752	717.2971	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7709	0.8321	0.8031	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	684.7776	581.8463	576.0595	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	983.9588	940.5265	875.7150	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	215.4105	266.8580	222.9437	0.0000	0.0000	0.0000	0.0000	(104)

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Space cooling												705.2122 (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	53.8526	66.7145	55.7359	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												176.3031 (107)
Space cooling per m2												1.9550 (108)
Energy for space heating												38.7080 (99)
Energy for space cooling												1.9550 (108)
Total												40.6630 (109)
Dwelling Fabric Energy Efficiency (DFEE)												40.7 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.3727	0.3792	0.3727	0.3269	0.3008	0.2877	0.2615	0.2681	0.3008	0.3400	0.3465	0.3335	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.6227	0.6292	0.6227	0.5769	0.5508	0.5377	0.5115	0.5181	0.5508	0.5900	0.5965	0.5835	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.8447	45.3156	44.8447	41.5485	39.6650	38.7232	36.8397	37.3106	39.6650	42.4903	42.9611	42.0194	(38)
Heat transfer coeff	101.1095	101.5804	101.1095	97.8134	95.9299	94.9881	93.1046	93.5754	95.9299	98.7551	99.2260	98.2843	(39)
Average = Sum(39)m / 12 =												97.6172	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1212	1.1264	1.1212	1.0846	1.0638	1.0533	1.0324	1.0377	1.0638	1.0951	1.1003	1.0899	(40)
HLP (average)												1.0825	(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	2.6282	(42)
Average daily hot water use (litres/day)	101.7044	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)
Water storage loss:													

CALCULATION OF HEAT DEMAND 09 Jan 2014

Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	228.5086	201.6467	212.3352	191.1235	187.8591	168.6699	162.7607	177.5357	176.8890	198.1459	208.5395	223.2736	(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													
	228.5086	201.6467	212.3352	191.1235	187.8591	168.6699	162.7607	177.5357	176.8890	198.1459	208.5395	223.2736	(64)
Total per year (kWh/year) = Sum(64)m =												2337.2874	(64)
RHI water heating demand												2337	(64)
Heat gains from water heating, kWh/month													
	105.2453	93.4815	99.8676	91.8707	91.7293	84.4048	83.3841	88.2968	87.1377	95.1497	97.6615	103.5046	(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	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3158	50.0192	40.6784	30.7961	23.0205	19.4349	21.0001	27.2967	36.6375	46.5198	54.2954	57.8810	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.3261	361.0340	351.6902	331.7982	306.6882	283.0883	267.3221	263.6142	272.9581	292.8500	317.9601	341.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	141.4587	139.1093	134.2306	127.5981	123.2921	117.2289	112.0754	118.6785	121.0245	127.8894	135.6409	139.1191	(72)
Total internal gains													
	664.0614	659.1234	635.5600	599.1533	561.9615	528.7128	509.3583	518.5501	539.5809	576.2199	616.8572	647.5209	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	8.2005	0.6300	0.7000	0.7700	3.6089	(74)
East	6.5300	14.7869	0.6300	0.7000	0.7700	29.5096	(76)
South	0.9000	38.1750	0.6300	0.7000	0.7700	10.5001	(78)
West	4.7600	14.7869	0.6300	0.7000	0.7700	21.5108	(80)

Solar gains	65.1294	141.0607	249.6490	364.8764	468.1924	444.1966	421.9653	357.9784	271.8196	162.0639	83.4414	49.3077	(83)
Total gains	729.1908	800.1841	885.2090	964.0297	1030.1539	972.9094	931.3236	876.5285	811.4005	738.2838	700.2986	696.8286	(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	24.7751	24.6603	24.7751	25.6100	26.1128	26.3717	26.9052	26.7698	26.1128	25.3658	25.2454	25.4873	
alpha	2.6517	2.6440	2.6517	2.7073	2.7409	2.7581	2.7937	2.7847	2.7409	2.6911	2.6830	2.6992	
util living area													
	0.9431	0.9287	0.8971	0.8408	0.7633	0.6760	0.5953	0.6274	0.7550	0.8760	0.9283	0.9500	(86)
MIT	18.7949	18.9539	19.3518	19.8871	20.3136	20.6348	20.7991	20.7641	20.4879	19.8730	19.2501	18.7400	(87)
Th 2	19.9836	19.9793	19.9836	20.0134	20.0305	20.0391	20.0564	20.0521	20.0305	20.0048	20.0006	20.0091	(88)
util rest of house													
	0.9356	0.9195	0.8837	0.8199	0.7324	0.6299	0.5364	0.5690	0.7134	0.8556	0.9177	0.9435	(89)
MIT 2	17.0390	17.2642	17.8359	18.6102	19.2083	19.6434	19.8617	19.8197	19.4577	18.6002	17.7086	16.9743	(90)
Living area fraction									fLA = Living area / (4) =			0.1796	(91)
MIT	17.3544	17.5678	18.1082	18.8395	19.4069	19.8215	20.0301	19.9894	19.6428	18.8288	17.9855	17.2915	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2044	17.4178	17.9582	18.6895	19.2569	19.6715	19.8801	19.8394	19.4928	18.6788	17.8355	17.1415	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9071	0.8883	0.8493	0.7864	0.7044	0.6104	0.5245	0.5547	0.6869	0.8212	0.8869	0.9173	(94)
Useful gains	661.4740	710.7986	751.8363	758.0950	725.6644	593.8673	488.4587	486.1803	557.3299	606.2665	621.0981	639.2081	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)
Heat loss rate W													
	1405.8713	1403.6136	1310.2007	1133.6126	955.1638	709.7023	547.4657	555.7802	718.7804	975.5822	1204.1578	1399.7185	(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													
	553.8316	465.5717	415.4231	270.3727	170.7475	0.0000	0.0000	0.0000	0.0000	274.7709	419.8030	565.8198	(98)
Space heating												3136.3403	(98)
RHI space heating demand												3136	(98)

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(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	0.3335	0.3269	0.3204	0.2877	0.2812	0.2485	0.2485	0.2419	0.2615	0.2812	0.2942	0.3073	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.5835	0.5769	0.5704	0.5377	0.5312	0.5000	0.5000	0.5000	0.5115	0.5312	0.5442	0.5573	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0194	41.5485	41.0776	38.7232	38.2523	36.0089	36.0089	36.0089	36.8397	38.2523	39.1941	40.1359	(38)
Heat transfer coeff	98.2843	97.8134	97.3425	94.9881	94.5172	92.2737	92.2737	92.2737	93.1046	94.5172	95.4590	96.4007	(39)
Average = Sum(39)m / 12 =												94.9373	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0899	1.0846	1.0794	1.0533	1.0481	1.0232	1.0232	1.0232	1.0324	1.0481	1.0585	1.0690	(40)
HLP (average)												1.0528	(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		2.6282 (42)
Average daily hot water use (litres/day)		101.7044 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)

Water storage loss:

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Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	228.5086	201.6467	212.3352	191.1235	187.8591	168.6699	162.7607	177.5357	176.8890	198.1459	208.5395	223.2736	(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)
FGHRS	-30.8955	-26.9927	-27.4234	-23.0716	-17.0462	-10.4035	-10.0411	-10.9497	-10.9090	-23.0409	-27.1350	-30.2654	eq.(G6)
Output from w/h													
	197.6131	174.6540	184.9118	168.0519	170.8130	158.2664	152.7196	166.5859	165.9800	175.1050	181.4045	193.0082	(64)
								Total per year (kWh/year) = Sum(64)m =				2089.1134	(64)
Heat gains from water heating, kWh/month													
	105.2453	93.4815	99.8676	91.8707	91.7293	84.4048	83.3841	88.2968	87.1377	95.1497	97.6615	103.5046	(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	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3158	50.0192	40.6784	30.7961	23.0205	19.4349	21.0001	27.2967	36.6375	46.5198	54.2954	57.8810	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.3261	361.0340	351.6902	331.7982	306.6882	283.0883	267.3221	263.6142	272.9581	292.8500	317.9601	341.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	141.4587	139.1093	134.2306	127.5981	123.2921	117.2289	112.0754	118.6785	121.0245	127.8894	135.6409	139.1191	(72)
Total internal gains													
	664.0614	659.1234	635.5600	599.1533	561.9615	528.7128	509.3583	518.5501	539.5809	576.2199	616.8572	647.5209	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	6.5300	19.6403	0.6300	0.7000	0.7700	39.1951	(76)
South	0.9000	46.7521	0.6300	0.7000	0.7700	12.8592	(78)
West	4.7600	19.6403	0.6300	0.7000	0.7700	28.5710	(80)

Solar gains	85.3050	162.5681	260.3388	373.1296	454.6884	465.0577	442.8665	381.5915	300.2048	190.6603	105.5119	70.7403	(83)
Total gains	749.3664	821.6914	895.8988	972.2829	1016.6499	993.7706	952.2249	900.1416	839.7857	766.8802	722.3691	718.2612	(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	25.4873	25.6100	25.7339	26.3717	26.5031	27.1475	27.1475	27.1475	26.9052	26.5031	26.2416	25.9853	
alpha	2.6992	2.7073	2.7156	2.7581	2.7669	2.8098	2.8098	2.8098	2.7937	2.7669	2.7494	2.7324	
util living area													
	0.9307	0.9097	0.8696	0.7919	0.6791	0.5295	0.4032	0.4396	0.6317	0.8179	0.9046	0.9366	(86)
MIT	19.0902	19.3231	19.7158	20.2224	20.6127	20.8666	20.9542	20.9404	20.7688	20.2695	19.6223	19.0701	(87)
Th 2	20.0091	20.0134	20.0177	20.0391	20.0434	20.0640	20.0640	20.0640	20.0564	20.0434	20.0348	20.0262	(88)
util rest of house													
	0.9214	0.8978	0.8522	0.7641	0.6358	0.4672	0.3251	0.3603	0.5716	0.7875	0.8903	0.9281	(89)
MIT 2	17.4800	17.8148	18.3748	19.0930	19.6156	19.9429	20.0336	20.0221	19.8310	19.1752	18.2619	17.4617	(90)
Living area fraction									fLA = Living area / (4) =			0.1796	(91)
MIT	17.7693	18.0858	18.6157	19.2959	19.7948	20.1088	20.1989	20.1871	19.9994	19.3718	18.5063	17.7506	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6193	17.9358	18.4657	19.1459	19.6448	19.9588	20.0489	20.0371	19.8494	19.2218	18.3563	17.6006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8913	0.8654	0.8183	0.7343	0.6159	0.4598	0.3238	0.3579	0.5572	0.7564	0.8580	0.8995	(94)
Useful gains	667.9421	711.0744	733.1037	713.9176	626.2008	456.8984	308.3522	322.1331	467.9342	580.0837	619.7632	646.0464	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1309.0733	1275.0717	1164.7679	973.2383	750.9156	494.4791	318.2472	335.6072	535.2985	814.9093	1074.5121	1291.8281	(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													
	477.0016	379.0062	321.1581	186.7109	92.7878	0.0000	0.0000	0.0000	0.0000	174.7102	327.4192	480.4615	(98)
Space heating												2439.2556	(98)
Space heating per m2											(98) / (4) =	27.0487	(99)

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8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												91.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	477.0016	379.0062	321.1581	186.7109	92.7878	0.0000	0.0000	0.0000	0.0000	174.7102	327.4192	480.4615	(98)
Space heating efficiency (main heating system 1)													
	91.8000	91.8000	91.8000	91.8000	91.8000	0.0000	0.0000	0.0000	0.0000	91.8000	91.8000	91.8000	(210)
Space heating fuel (main heating system)													
	519.6096	412.8608	349.8455	203.3887	101.0761	0.0000	0.0000	0.0000	0.0000	190.3161	356.6658	523.3786	(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													
	197.6131	174.6540	184.9118	168.0519	170.8130	158.2664	152.7196	166.5859	165.9800	175.1050	181.4045	193.0082	(64)
Efficiency of water heater												81.1000	(216)
(217)m	88.3842	88.1320	87.5781	86.4001	84.5698	81.1000	81.1000	81.1000	81.1000	86.1129	87.6759	88.4554	(217)
Fuel for water heating, kWh/month													
	223.5842	198.1732	211.1394	194.5042	201.9787	195.1497	188.3103	205.4081	204.6609	203.3436	206.9034	218.1983	(219)
Water heating fuel used												2451.3540	(219)
Annual totals kWh/year													
Space heating fuel - main system												2657.1411	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 9.4900, total flow = 42.0000, SFP = 0.2260)													
mechanical ventilation fans (SFP = 0.2260)												60.1592	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												135.1592	(231)
Electricity for lighting (calculated in Appendix L)												397.8222	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.01 * 908 * 1.00) =										-733.5462		-733.5462	(233)
Total delivered energy for all uses												4907.9303	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2657.1411	7.6000	201.9427	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2451.3540	7.6000	186.3029	(247)
Mechanical ventilation fans	60.1592	13.1900	7.9350	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	397.8222	13.1900	52.4727	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-733.5462	13.1900	-96.7547	(252)
Total energy cost			431.7911	(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] =	1.3416	(257)
SAP value		81.2852	
SAP rating (Section 12)		81	(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	2657.1411	0.2410	640.3710	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2451.3540	0.2410	590.7763	(264)
Space and water heating			1231.1473	(265)
Pumps and fans	135.1592	0.5190	70.1476	(267)
Energy for lighting	397.8222	0.5190	206.4697	(268)
Energy saving/generation technologies				
PV Unit	-733.5462	0.5190	-380.7105	(269)
Total kg/year			1127.0542	(272)
CO2 emissions per m2			12.5000	(273)
EI value			88.8278	
EI rating			89	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	7.60 × (1 + 0.29 × 0.00) / 0.9180 = 8.279, stars = 2
Main heating environmental impact	0.241 × (1 + 0.29 × 0.00) / 0.9180 = 0.2625, stars = 4
Water heating energy efficiency	7.60 / 0.8514 = 8.926, stars = 3
Water heating environmental impact	0.241 / 0.8514 = 0.2831, stars = 5

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.3727	0.3792	0.3727	0.3269	0.3008	0.2877	0.2615	0.2681	0.3008	0.3400	0.3465	0.3335	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.6227	0.6292	0.6227	0.5769	0.5508	0.5377	0.5115	0.5181	0.5508	0.5900	0.5965	0.5835	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6840	(36)
Total fabric heat loss (33) + (36) =	56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.8447	45.3156	44.8447	41.5485	39.6650	38.7232	36.8397	37.3106	39.6650	42.4903	42.9611	42.0194	(38)
Heat transfer coeff	101.1095	101.5804	101.1095	97.8134	95.9299	94.9881	93.1046	93.5754	95.9299	98.7551	99.2260	98.2843	(39)
Average = Sum(39)m / 12 =												97.6172	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1212	1.1264	1.1212	1.0846	1.0638	1.0533	1.0324	1.0377	1.0638	1.0951	1.1003	1.0899	(40)
HLP (average)												1.0825	(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	2.6282 (42)
Average daily hot water use (litres/day)	101.7044 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)

Water storage loss:

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

Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	228.5086	201.6467	212.3352	191.1235	187.8591	168.6699	162.7607	177.5357	176.8890	198.1459	208.5395	223.2736	(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)
FGHRS	-31.6257	-27.7686	-28.2803	-24.4753	-21.6349	-10.4035	-10.0411	-10.9497	-10.9090	-25.2571	-27.9703	-31.0657	eq.(G6)
Output from w/h													
	196.8829	173.8781	184.0548	166.6482	166.2242	158.2664	152.7196	166.5859	165.9800	172.8889	180.5691	192.2079	(64)
								Total per year (kWh/year) = Sum(64)m =				2076.9062	(64)
Heat gains from water heating, kWh/month													
	105.2453	93.4815	99.8676	91.8707	91.7293	84.4048	83.3841	88.2968	87.1377	95.1497	97.6615	103.5046	(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	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3158	50.0192	40.6784	30.7961	23.0205	19.4349	21.0001	27.2967	36.6375	46.5198	54.2954	57.8810	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.3261	361.0340	351.6902	331.7982	306.6882	283.0883	267.3221	263.6142	272.9581	292.8500	317.9601	341.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	141.4587	139.1093	134.2306	127.5981	123.2921	117.2289	112.0754	118.6785	121.0245	127.8894	135.6409	139.1191	(72)
Total internal gains													
	664.0614	659.1234	635.5600	599.1533	561.9615	528.7128	509.3583	518.5501	539.5809	576.2199	616.8572	647.5209	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	8.2005	0.6300	0.7000	0.7700	3.6089	(74)
East	6.5300	14.7869	0.6300	0.7000	0.7700	29.5096	(76)
South	0.9000	38.1750	0.6300	0.7000	0.7700	10.5001	(78)
West	4.7600	14.7869	0.6300	0.7000	0.7700	21.5108	(80)

Solar gains	65.1294	141.0607	249.6490	364.8764	468.1924	444.1966	421.9653	357.9784	271.8196	162.0639	83.4414	49.3077	(83)
Total gains	729.1908	800.1841	885.2090	964.0297	1030.1539	972.9094	931.3236	876.5285	811.4005	738.2838	700.2986	696.8286	(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	24.7751	24.6603	24.7751	25.6100	26.1128	26.3717	26.9052	26.7698	26.1128	25.3658	25.2454	25.4873	
alpha	2.6517	2.6440	2.6517	2.7073	2.7409	2.7581	2.7937	2.7847	2.7409	2.6911	2.6830	2.6992	
util living area													
	0.9431	0.9287	0.8971	0.8408	0.7633	0.6760	0.5953	0.6274	0.7550	0.8760	0.9283	0.9500	(86)
MIT	18.7949	18.9539	19.3518	19.8871	20.3136	20.6348	20.7991	20.7641	20.4879	19.8730	19.2501	18.7400	(87)
Th 2	19.9836	19.9793	19.9836	20.0134	20.0305	20.0391	20.0564	20.0521	20.0305	20.0048	20.0006	20.0091	(88)
util rest of house													
	0.9356	0.9195	0.8837	0.8199	0.7324	0.6299	0.5364	0.5690	0.7134	0.8556	0.9177	0.9435	(89)
MIT 2	17.0390	17.2642	17.8359	18.6102	19.2083	19.6434	19.8617	19.8197	19.4577	18.6002	17.7086	16.9743	(90)
Living area fraction										fLA = Living area / (4) =		0.1796	(91)
MIT	17.3544	17.5678	18.1082	18.8395	19.4069	19.8215	20.0301	19.9894	19.6428	18.8288	17.9855	17.2915	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2044	17.4178	17.9582	18.6895	19.2569	19.6715	19.8801	19.8394	19.4928	18.6788	17.8355	17.1415	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9071	0.8883	0.8493	0.7864	0.7044	0.6104	0.5245	0.5547	0.6869	0.8212	0.8869	0.9173	(94)
Useful gains	661.4740	710.7986	751.8363	758.0950	725.6644	593.8673	488.4587	486.1803	557.3299	606.2665	621.0981	639.2081	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)
Heat loss rate W													
	1405.8713	1403.6136	1310.2007	1133.6126	955.1638	709.7023	547.4657	555.7802	718.7804	975.5822	1204.1578	1399.7185	(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													
	553.8316	465.5717	415.4231	270.3727	170.7475	0.0000	0.0000	0.0000	0.0000	274.7709	419.8030	565.8198	(98)
Space heating												3136.3403	(98)
Space heating per m2											(98) / (4) =	34.7787	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												91.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	553.8316	465.5717	415.4231	270.3727	170.7475	0.0000	0.0000	0.0000	0.0000	274.7709	419.8030	565.8198	(98)
Space heating efficiency (main heating system 1)													
	91.8000	91.8000	91.8000	91.8000	91.8000	0.0000	0.0000	0.0000	0.0000	91.8000	91.8000	91.8000	(210)
Space heating fuel (main heating system)													
	603.3024	507.1587	452.5306	294.5236	185.9994	0.0000	0.0000	0.0000	0.0000	299.3147	457.3018	616.3614	(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													
	196.8829	173.8781	184.0548	166.6482	166.2242	158.2664	152.7196	166.5859	165.9800	172.8889	180.5691	192.2079	(64)
Efficiency of water heater												81.1000	(216)
(217)m	88.7298	88.6207	88.2262	87.4027	86.1905	81.1000	81.1000	81.1000	81.1000	87.3492	88.2963	88.8283	(217)
Fuel for water heating, kWh/month													
	221.8904	196.2049	208.6171	190.6671	192.8568	195.1497	188.3103	205.4081	204.6609	197.9285	204.5037	216.3814	(219)
Water heating fuel used												2422.5786	(219)
Annual totals kWh/year													
Space heating fuel - main system												3416.4927	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 9.4900, total flow = 42.0000, SFP = 0.2260)													
mechanical ventilation fans (SFP = 0.2260)												60.1592	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												135.1592	(231)
Electricity for lighting (calculated in Appendix L)												397.8222	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.01 * 837 * 1.00) =										-676.5289		-676.5289	(233)
Total delivered energy for all uses												5695.5238	(238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3416.4927	6.9800	238.4712	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2422.5786	6.9800	169.0960	(247)
Mechanical ventilation fans	60.1592	22.5500	13.5659	(249)
Pumps and fans for heating	75.0000	22.5500	16.9125	(249)
Energy for lighting	397.8222	22.5500	89.7089	(250)
Additional standing charges			63.0000	(251)
Energy saving/generation technologies				
PV Unit	-676.5289	22.5500	-152.5573	(252)
Total energy cost			438.1972	(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	3416.4927	0.2410	823.3747	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2422.5786	0.2410	583.8414	(264)
Space and water heating			1407.2162	(265)
Pumps and fans	135.1592	0.5190	70.1476	(267)
Energy for lighting	397.8222	0.5190	206.4697	(268)
Energy saving/generation technologies				
PV Unit	-676.5289	0.5190	-351.1185	(269)
Total kg/year			1332.7151	(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	3416.4927	1.0900	3723.9770	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2422.5786	1.0900	2640.6107	(264)
Space and water heating			6364.5877	(265)
Pumps and fans	135.1592	3.0700	414.9389	(267)
Energy for lighting	397.8222	3.0700	1221.3142	(268)
Energy saving/generation technologies				

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

PV Unit	-676.5289	3.0700	-2076.9437 (269)
Primary energy kWh/year			5923.8970 (272)
Primary energy kWh/m2/year			65.6897 (273)

SAP 2012 EPC IMPROVEMENTS

(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	+ 3.7	-£ 70	-255 kg (19.1%)

Current energy efficiency rating: B 81
Current environmental impact rating: B 89

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£70	2.83 kg/m²	B 85	B 91
Total Savings	£70	2.83 kg/m²		

Potential energy efficiency rating: B 85
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, North East Scotland):

	Current	Potential	Saving
Electricity	£120	£131	-£11
Bulk LPG	£471	£389	£81
Space heating	£332	£335	-£3
Water heating	£169	£96	£73
Lighting	£90	£90	£0
Generated (PV)	-£153	-£153	£0
Total cost of fuels	£438	£367	£70
Total cost of uses	£438	£368	£70
Delivered energy	63 kWh/m²	51 kWh/m²	12 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.1 tonnes	0.3 tonnes
CO2 emissions per m²	15 kg/m²	12 kg/m²	3 kg/m²
Primary energy	66 kWh/m²	53 kWh/m²	12 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	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(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	0.3335	0.3269	0.3204	0.2877	0.2812	0.2485	0.2485	0.2419	0.2615	0.2812	0.2942	0.3073	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.5835	0.5769	0.5704	0.5377	0.5312	0.5000	0.5000	0.5000	0.5115	0.5312	0.5442	0.5573	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.0194	41.5485	41.0776	38.7232	38.2523	36.0089	36.0089	36.0089	36.8397	38.2523	39.1941	40.1359	(38)
Heat transfer coeff	98.2843	97.8134	97.3425	94.9881	94.5172	92.2737	92.2737	92.2737	93.1046	94.5172	95.4590	96.4007	(39)
Average = Sum(39)m / 12 =												94.9373	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0899	1.0846	1.0794	1.0533	1.0481	1.0232	1.0232	1.0232	1.0324	1.0481	1.0585	1.0690	(40)
HLP (average)												1.0528	(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		2.6282 (42)
Average daily hot water use (litres/day)		101.7044 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)

Water storage loss:

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	27.5373	24.8724	27.5373	26.6490	27.5373	26.6490	27.5373	27.5373	26.6490	27.5373	26.6490	27.5373	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	216.7069	190.9871	199.1377	172.9489	163.2631	144.6422	137.9321	153.6375	160.0651	184.9485	197.1185	211.4719	(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												1.1334	(H8)
Utilisation factor												0.5862	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												127.5000	(H13)
Daily hot water demand												101.7044	(H14)
Volume ratio Veff/V												1.2536	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-934.7821	(H17)
Solar input	-27.1068	-45.2335	-77.0378	-103.2458	-127.5515	-125.4035	-123.7462	-108.1177	-84.6778	-57.8250	-32.1526	-22.6838	(63)
								Solar input (sum of months) = Sum(63)m =				-934.7821	(63)
FGHRS	-26.7447	-20.5519	-16.3870	-7.2188	0.0000	0.0000	0.0000	-2.8188	-4.6582	-15.5696	-22.4240	-26.6712	eq.(G6)
Output from w/h													
	162.8553	125.2017	105.7129	62.4843	35.7116	19.2387	14.1858	42.7010	70.7290	111.5539	142.5419	162.1170	(64)
								Total per year (kWh/year) = Sum(64)m =				1055.0332	(64)
Heat gains from water heating, kWh/month													
	95.8039	84.9538	89.3096	77.3310	72.0525	65.1826	63.5212	69.1782	73.6786	84.5917	88.5247	94.0633	(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	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3158	50.0192	40.6784	30.7961	23.0205	19.4349	21.0001	27.2967	36.6375	46.5198	54.2954	57.8810	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.3261	361.0340	351.6902	331.7982	306.6882	283.0883	267.3221	263.6142	272.9581	292.8500	317.9601	341.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	128.7687	126.4193	120.0398	107.4041	96.8448	90.5315	85.3779	92.9815	102.3313	113.6986	122.9509	126.4291	(72)
Total internal gains													
	651.3714	646.4334	621.3692	578.9593	535.5142	502.0154	482.6609	492.8531	520.8877	562.0291	604.1672	634.8309	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	6.5300	19.6403	0.6300	0.7000	0.7700	39.1951	(76)
South	0.9000	46.7521	0.6300	0.7000	0.7700	12.8592	(78)
West	4.7600	19.6403	0.6300	0.7000	0.7700	28.5710	(80)

Solar gains	85.3050	162.5681	260.3388	373.1296	454.6884	465.0577	442.8665	381.5915	300.2048	190.6603	105.5119	70.7403	(83)
Total gains	736.6764	809.0014	881.7080	952.0889	990.2025	967.0731	925.5274	874.4446	821.0925	752.6894	709.6791	705.5712	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	25.4873	25.6100	25.7339	26.3717	26.5031	27.1475	27.1475	27.1475	26.9052	26.5031	26.2416	25.9853	
alpha	2.6992	2.7073	2.7156	2.7581	2.7669	2.8098	2.8098	2.8098	2.7937	2.7669	2.7494	2.7324	
util living area													
	0.9331	0.9125	0.8734	0.7987	0.6894	0.5405	0.4133	0.4504	0.6408	0.8235	0.9079	0.9390	(86)
MIT	19.0699	19.3042	19.6974	20.2028	20.5967	20.8594	20.9513	20.9366	20.7599	20.2542	19.6036	19.0493	(87)
Th 2	20.0091	20.0134	20.0177	20.0391	20.0434	20.0640	20.0640	20.0640	20.0564	20.0434	20.0348	20.0262	(88)
util rest of house													
	0.9241	0.9009	0.8563	0.7714	0.6464	0.4777	0.3338	0.3698	0.5808	0.7936	0.8939	0.9307	(89)
MIT 2	17.4512	17.7883	18.3495	19.0674	19.5967	19.9358	20.0314	20.0192	19.8215	19.1554	18.2359	17.4320	(90)
Living area fraction									fLA = Living area / (4) =			0.1796	(91)
MIT	17.7420	18.0606	18.5917	19.2713	19.7763	20.1017	20.1967	20.1840	19.9901	19.3528	18.4816	17.7226	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5920	17.9106	18.4417	19.1213	19.6263	19.9517	20.0467	20.0340	19.8401	19.2028	18.3316	17.5726	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8944	0.8687	0.8224	0.7410	0.6257	0.4697	0.3322	0.3670	0.5657	0.7622	0.8619	0.9025	(94)
Useful gains	658.8902	702.7409	725.1185	705.5438	619.5706	454.1996	307.4795	320.9647	464.5008	573.7041	611.6511	636.7824	(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													
	1306.3938	1272.6100	1162.4329	970.9037	749.1760	493.8248	318.0380	335.3263	534.4256	813.1151	1072.1543	1289.1241	(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													
	481.7427	382.9520	325.3619	191.0591	96.4264	0.0000	0.0000	0.0000	0.0000	178.1218	331.5623	485.3422	(98)
Space heating												2472.5684	(98)
Space heating per m2											(98) / (4) =	27.4181	(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 %)	91.8000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	481.7427	382.9520	325.3619	191.0591	96.4264	0.0000	0.0000	0.0000	0.0000	178.1218	331.5623	485.3422	(98)
Space heating efficiency (main heating system 1)													
	91.8000	91.8000	91.8000	91.8000	91.8000	0.0000	0.0000	0.0000	0.0000	91.8000	91.8000	91.8000	(210)
Space heating fuel (main heating system)													
	524.7742	417.1591	354.4247	208.1254	105.0396	0.0000	0.0000	0.0000	0.0000	194.0324	361.1790	528.6952	(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													
	162.8553	125.2017	105.7129	62.4843	35.7116	19.2387	14.1858	42.7010	70.7290	111.5539	142.5419	162.1170	(64)
Efficiency of water heater												81.1000	(216)
(217)m	88.8387	88.9098	88.9229	88.9091	88.6394	81.1000	81.1000	81.1000	81.1000	87.3613	88.2975	88.8643	(217)
Fuel for water heating, kWh/month													
	183.3157	140.8187	118.8815	70.2789	40.2886	23.7222	17.4918	52.6523	87.2121	127.6926	161.4337	182.4320	(219)
Water heating fuel used												1206.2201	(219)
Annual totals kWh/year													
Space heating fuel - main system												2693.4296	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 9.4900, total flow = 42.0000, SFP = 0.2260)													
mechanical ventilation fans (SFP = 0.2260)												60.1592	(230a)
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												185.1592	(231)
Electricity for lighting (calculated in Appendix L)												397.8222	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.01 * 908 * 1.00) =										-733.5462		-733.5462	(233)
Total delivered energy for all uses												3749.0849	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2693.4296	7.6000	204.7007	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1206.2201	7.6000	91.6727	(247)
Mechanical ventilation fans	60.1592	13.1900	7.9350	(249)
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	397.8222	13.1900	52.4727	(250)
Additional standing charges			70.0000	(251)
Energy saving/generation technologies				
PV Unit	-733.5462	13.1900	-96.7547	(252)
Total energy cost			346.5139	(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] =	1.0766	(257)
SAP value	84.9813	
SAP rating (Section 12)	85	(258)
SAP band	B	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2693.4296	0.2410	649.1165	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1206.2201	0.2410	290.6990	(264)
Space and water heating			939.8156	(265)
Pumps and fans	185.1592	0.5190	96.0976	(267)
Energy for lighting	397.8222	0.5190	206.4697	(268)
Energy saving/generation technologies				
PV Unit	-733.5462	0.5190	-380.7105	(269)
Total kg/year			861.6725	(272)
CO2 emissions per m2			9.5600	(273)
EI value			91.4585	
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	90.1800 (1b)	x	2.4200 (2b)	=	218.2356	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	90.1800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	218.2356	(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) =	0.1375	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3375	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2615	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.7000	5.8000	5.7000	5.0000	4.6000	4.4000	4.0000	4.1000	4.6000	5.2000	5.3000	5.1000	(22)
Wind factor	1.4250	1.4500	1.4250	1.2500	1.1500	1.1000	1.0000	1.0250	1.1500	1.3000	1.3250	1.2750	(22a)
Adj infilt rate	0.3727	0.3792	0.3727	0.3269	0.3008	0.2877	0.2615	0.2681	0.3008	0.3400	0.3465	0.3335	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.6227	0.6292	0.6227	0.5769	0.5508	0.5377	0.5115	0.5181	0.5508	0.5900	0.5965	0.5835	(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	
Entrance Door			2.1000	1.4000	2.9400			(26)
Windows/ Patios (Uw = 1.40)			13.6300	1.3258	18.0701			(27)
Insulated slab 3DB 90			49.1000	0.1200	5.8920			(28a)
Render/ Blk T/Frame	82.0300	11.8300	70.2000	0.1600	11.2320			(29a)
Feature Stone	12.8300	3.9000	8.9300	0.1600	1.4288			(29a)
Horizontal	90.1800		90.1800	0.1000	9.0180			(30)
Total net area of external elements Aum(A, m2)			234.1400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5809			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.6840	(36)
Total fabric heat loss					(33) + (36) =		56.2649	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	44.8447	45.3156	44.8447	41.5485	39.6650	38.7232	36.8397	37.3106	39.6650	42.4903	42.9611	42.0194	(38)
Heat transfer coeff	101.1095	101.5804	101.1095	97.8134	95.9299	94.9881	93.1046	93.5754	95.9299	98.7551	99.2260	98.2843	(39)
Average = Sum(39)m / 12 =												97.6172	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1212	1.1264	1.1212	1.0846	1.0638	1.0533	1.0324	1.0377	1.0638	1.0951	1.1003	1.0899	(40)
HLP (average)												1.0825	(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	2.6282	(42)
Average daily hot water use (litres/day)	101.7044	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.8748	107.8067	103.7385	99.6703	95.6021	91.5340	91.5340	95.6021	99.6703	103.7385	107.8067	111.8748	(44)
Energy conte	165.9072	145.1035	149.7338	130.5415	125.2577	108.0879	100.1593	114.9343	116.3070	135.5445	147.9575	160.6722	(45)
Energy content (annual)										Total = Sum(45)m =		1600.2064	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8861	21.7655	22.4601	19.5812	18.7887	16.2132	15.0239	17.2401	17.4460	20.3317	22.1936	24.1008	(46)
Water storage loss:													

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

Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.3500	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.2690	(55)
Total storage loss													
	39.3390	35.5320	39.3390	38.0700	39.3390	38.0700	39.3390	39.3390	38.0700	39.3390	38.0700	39.3390	(56)
If cylinder contains dedicated solar storage													
	27.5373	24.8724	27.5373	26.6490	27.5373	26.6490	27.5373	27.5373	26.6490	27.5373	26.6490	27.5373	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	216.7069	190.9871	199.1377	172.9489	163.2631	144.6422	137.9321	153.6375	160.0651	184.9485	197.1185	211.4719	(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												1017.1843	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1708.8697	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.0679	(H8)
Utilisation factor												0.6080	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												127.5000	(H13)
Daily hot water demand												101.7044	(H14)
Volume ratio Veff/V												1.2536	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-913.5317	(H17)
Solar input	-21.7888	-41.3162	-77.6421	-105.7772	-137.2067	-124.9624	-123.0801	-106.1324	-80.4901	-51.7199	-26.7711	-16.6446	(63)
								Solar input (sum of months) = Sum(63)m =				-913.5317	(63)
FGHRS	-28.1192	-21.7261	-16.8291	-7.0683	0.0000	0.0000	0.0000	-2.9409	-4.9157	-17.9270	-23.8710	-28.2162	eq.(G6)
Output from w/h													
	166.7988	127.9448	104.6665	60.1034	26.0564	19.6798	14.8519	44.5642	74.6592	115.3015	146.4764	166.6112	(64)
								Total per year (kWh/year) = Sum(64)m =				1067.7142	(64)
Heat gains from water heating, kWh/month													
	95.8039	84.9538	89.3096	77.3310	72.0525	65.1826	63.5212	69.1782	73.6786	84.5917	88.5247	94.0633	(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	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	157.6906	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3158	50.0192	40.6784	30.7961	23.0205	19.4349	21.0001	27.2967	36.6375	46.5198	54.2954	57.8810	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.3261	361.0340	351.6902	331.7982	306.6882	283.0883	267.3221	263.6142	272.9581	292.8500	317.9601	341.5599	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	53.3972	(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)													
	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	-105.1271	(71)
Water heating gains (Table 5)													
	128.7687	126.4193	120.0398	107.4041	96.8448	90.5315	85.3779	92.9815	102.3313	113.6986	122.9509	126.4291	(72)
Total internal gains													
	651.3714	646.4334	621.3692	578.9593	535.5142	502.0154	482.6609	492.8531	520.8877	562.0291	604.1672	634.8309	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.4400	8.2005	0.6300	0.7000	0.7700	3.6089	(74)
East	6.5300	14.7869	0.6300	0.7000	0.7700	29.5096	(76)
South	0.9000	38.1750	0.6300	0.7000	0.7700	10.5001	(78)
West	4.7600	14.7869	0.6300	0.7000	0.7700	21.5108	(80)

Solar gains	65.1294	141.0607	249.6490	364.8764	468.1924	444.1966	421.9653	357.9784	271.8196	162.0639	83.4414	49.3077	(83)
Total gains	716.5008	787.4941	871.0182	943.8357	1003.7066	946.2120	904.6261	850.8316	792.7073	724.0930	687.6086	684.1386	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.7751	24.6603	24.7751	25.6100	26.1128	26.3717	26.9052	26.7698	26.1128	25.3658	25.2454	25.4873	
alpha	2.6517	2.6440	2.6517	2.7073	2.7409	2.7581	2.7937	2.7847	2.7409	2.6911	2.6830	2.6992	
util living area													
	0.9451	0.9310	0.9002	0.8465	0.7722	0.6869	0.6072	0.6395	0.7631	0.8804	0.9309	0.9519	(86)
MIT	18.7739	18.9339	19.3318	19.8635	20.2907	20.6189	20.7885	20.7521	20.4723	19.8542	19.2300	18.7184	(87)
Th 2	19.9836	19.9793	19.9836	20.0134	20.0305	20.0391	20.0564	20.0521	20.0305	20.0048	20.0006	20.0091	(88)
util rest of house													
	0.9379	0.9220	0.8871	0.8261	0.7419	0.6411	0.5481	0.5811	0.7221	0.8604	0.9207	0.9457	(89)
MIT 2	17.0091	17.2359	17.8079	18.5783	19.1788	19.6248	19.8506	19.8068	19.4385	18.5747	17.6802	16.9433	(90)
Living area fraction									fLA = Living area / (4) =			0.1796	(91)
MIT	17.3261	17.5409	18.0817	18.8092	19.3785	19.8034	20.0191	19.9766	19.6242	18.8045	17.9586	17.2622	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1761	17.3909	17.9317	18.6592	19.2285	19.6534	19.8691	19.8266	19.4742	18.6545	17.8086	17.1122	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9099	0.8912	0.8529	0.7924	0.7132	0.6207	0.5354	0.5659	0.6949	0.8261	0.8903	0.9200	(94)
Useful gains	651.9409	701.7985	742.9321	747.8709	715.8402	587.3204	484.3535	481.4744	550.8732	598.1660	612.1563	629.3988	(95)
Ext temp.	3.3000	3.6000	5.0000	7.1000	9.3000	12.2000	14.0000	13.9000	12.0000	8.8000	5.7000	2.9000	(96)
Heat loss rate W	1403.0055	1400.8902	1307.5139	1130.6412	952.4438	707.9810	546.4390	554.5820	717.0004	973.1840	1201.4918	1396.8321	(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	558.7921	469.7896	420.0489	275.5946	176.0331	0.0000	0.0000	0.0000	0.0000	279.0134	424.3216	570.9704	(98)
Space heating												3174.5636	(98)
Space heating per m2											(98) / (4) =	35.2025	(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 %)	91.8000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	558.7921	469.7896	420.0489	275.5946	176.0331	0.0000	0.0000	0.0000	0.0000	279.0134	424.3216	570.9704	(98)
Space heating efficiency (main heating system 1)	91.8000	91.8000	91.8000	91.8000	91.8000	0.0000	0.0000	0.0000	0.0000	91.8000	91.8000	91.8000	(210)
Space heating fuel (main heating system)	608.7060	511.7534	457.5696	300.2119	191.7572	0.0000	0.0000	0.0000	0.0000	303.9361	462.2239	621.9721	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	166.7988	127.9448	104.6665	60.1034	26.0564	19.6798	14.8519	44.5642	74.6592	115.3015	146.4764	166.6112	(64)
Efficiency of water heater												81.1000	(216)
(217)m	89.0977	89.2787	89.4460	89.6816	90.2645	81.1000	81.1000	81.1000	81.1000	88.3900	88.7937	89.1433	(217)
Fuel for water heating, kWh/month	187.2089	143.3094	117.0165	67.0186	28.8667	24.2661	18.3131	54.9498	92.0582	130.4464	164.9625	186.9027	(219)
Water heating fuel used												1215.3189	(219)
Annual totals kWh/year													
Space heating fuel - main system												3458.1302	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 9.4900, total flow = 42.0000, SFP = 0.2260)		
mechanical ventilation fans (SFP = 0.2260)	60.1592	(230a)
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	185.1592	(231)
Electricity for lighting (calculated in Appendix L)	397.8222	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 1.01 * 837 * 1.00) = -676.5289	-676.5289	(233)
Total delivered energy for all uses	4579.9017	(238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3458.1302	6.9800	241.3775	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1215.3189	6.9800	84.8293	(247)
Mechanical ventilation fans	60.1592	22.5500	13.5659	(249)
Pumps and fans for heating	75.0000	22.5500	16.9125	(249)
Pump for solar water heating	50.0000	22.5500	11.2750	(249)
Energy for lighting	397.8222	22.5500	89.7089	(250)
Additional standing charges			63.0000	(251)
Energy saving/generation technologies				
PV Unit	-676.5289	22.5500	-152.5573	(252)
Total energy cost			368.1118	(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	3458.1302	0.2410	833.4094	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1215.3189	0.2410	292.8919	(264)
Space and water heating			1126.3012	(265)
Pumps and fans	185.1592	0.5190	96.0976	(267)

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

Energy for lighting	397.8222	0.5190	206.4697 (268)
Energy saving/generation technologies			
PV Unit	-676.5289	0.5190	-351.1185 (269)
Total kg/year			1077.7501 (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	3458.1302	1.0900	3769.3620	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1215.3189	1.0900	1324.6976	(264)
Space and water heating			5094.0596	(265)
Pumps and fans	185.1592	3.0700	568.4389	(267)
Energy for lighting	397.8222	3.0700	1221.3142	(268)
Energy saving/generation technologies				
PV Unit	-676.5289	3.0700	-2076.9437	(269)
Primary energy kWh/year			4806.8690	(272)
Primary energy kWh/m2/year			53.3030	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc cregash 101	**Issued on Date**	23/01/2023
Assessment Reference	3db 90	**Prop Type Ref**	
Project	3DB 90, plot 101, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	81 B	**DER**	13.78	**TER**	14.78
Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Roof 000001

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Earthwool Loft Roll 40 over ceiling**				
	Main construction	200	0.0400	5.0000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Earthwool Loft Roll 40 in ceiling**				
	Main construction	200	0.0400	5.0000	92.17
	Main construction	200	0.1300	1.5385	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 9.805 m² K/W **Lower limit =** 9.450 m² K/W **Average =** 9.628 m² K/W

Total correction = 0.0019 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 413 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

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Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall Render Block T/Frame

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Render - Cement and Sand**				
	Main construction	20	1.0000	0.0200	100.00
Layer 2	**Blockwork, dense**				
	Main construction	100	1.5900	0.0629	100.00
Layer 3	**Low E perp vented cavity**				
	Main construction	50	0.0649	0.7700	100.00
Layer 4	**Reflective breather membrane**				
	Main construction	0.5	0.0000	0.0000	100.00
Layer 5	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0692	100.00
Layer 6	**Earthwool Frametherm Roll 35 in T/Frame**				
	Main construction	140	0.0350	4.0000	85.00
	Main construction	140	0.1300	1.0769	15.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**Thermawall TW55 over T/Frame**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 8	**Reflective VCL**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 9	**Low E battens cavity**				
	Main construction	38	0.0494	0.7687	89.03
	Main construction	38	0.1300	0.2923	10.97
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 10	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 6.560 m² K/W **Lower limit =** 6.010 m² K/W **Average =** 6.285 m² K/W

Total correction = 0.0025 m² K/W **U-value (unrounded) =** 0.16 W/m² K

Unheated space: None

Total thickness: 400 mm **U-value: 0.16 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc cregash 101	**Issued on Date**	23/01/2023
Assessment Reference	3db 90	**Prop Type Ref**	
Project	3DB 90, plot 101, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	81 B	**DER**	13.78	**TER**	14.78
Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Wall Feature stone

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Artificial stone**				
	Main construction	100	1.3000	0.0769	100.00
Layer 2	**Low E perp vented cavity**				
	Main construction	50	0.0649	0.7700	100.00
Layer 3	**Reflective breather membrane**				
	Main construction	0.5	0.0000	0.0000	100.00
Layer 4	**Orientated Strand Board**				
	Main construction	9	0.1300	0.0692	100.00
Layer 5	**Earthwool Frametherm Roll 35 in T/Frame**				
	Main construction	140	0.0350	4.0000	85.00
	Main construction	140	0.1300	1.0769	15.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 6	**Thermawall TW55 over T/Frame**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**Relective VCL**				
	Main construction	0.3	0.0000	0.0000	100.00
Layer 8	**Low E battens cavity**				
	Main construction	38	0.0494	0.7687	89.03
	Main construction	38	0.1300	0.2923	10.97
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 9	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 6.553 m² K/W **Lower limit =** 6.004 m² K/W **Average =** 6.279 m² K/W

Total correction = 0.0025 m² K/W **U-value (unrounded) =** 0.16 W/m² K

Unheated space: None

Total thickness: 380 mm **U-value: 0.16 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	ajc cregash 101	**Issued on Date**	23/01/2023
Assessment Reference	3db 90	**Prop Type Ref**	
Project	3DB 90, plot 101, Tarland Road, Aboyne		
Calculation Type	New Build (As Designed)		

SAP Rating	81 B	**DER**	13.78	**TER**	14.78
Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

Building Elements

Floor 3sv 98 Slab

Floor Type: Slab On Ground Floor
Area = 90.18 m², Perimeter = 39.20 m, Wall thickness = 379.00 mm, Soil: Unknown
Horizontal edge insulation: none
Vertical edge insulation: Width D = 150.0 mm, Thickness dn = 25.0 mm, Lambda = 0.022

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Sand blinded hardcore**				
	Main construction	200	2.3000	0.0870	100.00
Layer 2	**Polythene,1200 gauge**				
	Main construction	0.4	0.0000	0.0000	100.00
Layer 3	**Thermafloor TF70 zero ODP**				
	Main construction	150	0.0220	6.8182	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**Concrete, reinforced (1% steel)**				
	Main construction	150	2.3000	0.0652	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 6.970 m² K/W **Lower limit =** 6.970 m² K/W **Average =** 6.970 m² K/W

Total correction = 0.0096 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 500 mm **U-value: 0.12 W/m² K** **Kappa: n/a**

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

Design SAP
elmhurst energy

Property Reference	ajc cregash 101	**Issued on Date**	23/01/2023
Assessment Reference	3db 90	**Prop Type Ref**	
Property	3DB 90, plot 101, Tarland Road, Aboyne		

SAP Rating	81 B	**DER**	13.78	**TER**	14.78
Environmental	89 B	**% DER<TER**	6.77		
CO_2 Emissions (t/year)	1.33	**FEE**	40.66	**TFEE**	N/A
General Requirements Compliance	Pass	**% DFEE<TFEE**	N/A		

Assessor Details	Mr. William MacDougall, Northern Energy, Tel: 019755 81400, n.energy@btinternet.com	**Assessor ID**	1910-0001
Client			

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

Orientation	West
Property Tenure	Owner-occupied
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	1
3.0 Date Built	2018
4.0 Sheltered Sides	3
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	39.20 m	90.18 m²	2.42 m

7.0 Living Area	16.20	m²
8.0 Thermal Mass Parameter	Simple calculation - Low	
Thermal Mass	100.00	kJ/m²K

9.0 External Walls

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
Render/ Blk T/Frame	Timber Frame	0.16	82.03	70.20
Feature Stone	Timber Frame	0.16	12.83	8.93

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)

10.0 External Roofs

Description	Type	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
Horizontal	External Plane Roof	0.10	90.18	90.18

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Insulated slab 3DB 90	Ground Floor - Solid		0.12	49.10

12.0 Opening Types

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

Design SAP
elmhurst energy

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Entrance Door	Manufacturer	Solid Door							1.40
Windows/ Patios	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Gable glass	Window	[1] Render/ Blk T/Frame	South	None	0.00					0.90	
Rear Glass	Window	[1] Render/ Blk T/Frame	East	None	0.00					6.53	
Front door	Solid Door	[2] Feature Stone	West							2.10	
Front glass stone	Window	[2] Feature Stone	West	None	0.00					1.80	
Front Glass	Window	[1] Render/ Blk T/Frame	West	None	0.00					2.96	
Gable glass	Window	[1] Render/ Blk T/Frame	North	None	0.00					1.44	

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
Scotland ACD 2015	E2 Other lintels (including other steel lintels)	10.90	0.037	No
Scotland ACD 2015	E3 Sill	8.40	0.033	No
Scotland ACD 2015	E4 Jamb	27.90	0.031	No
Scotland ACD 2015	E5 Ground floor (normal)	39.20	0.097	No
Scotland ACD 2015	E10 Eaves (insulation at ceiling level)	9.30	0.043	No
Scotland ACD 2015	E12 Gable (insulation at ceiling level)	29.90	0.051	No
Scotland ACD 2015	E16 Corner (normal)	14.52	0.038	No
Scotland ACD 2015	E17 Corner (inverted – internal area greater than external area)	4.84	-0.029	No

Y-value	0.033	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	4.00	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	No
Night Ventilation	No
Air change rate	2.50

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Mechanical extract ventilation - decentralised
MV Reference Number	500537

Duct Type	Rigid

19.1 Mechanical extract ventilation - Decentralised

SFP	Fan/Room Type	Count
0.17	In Room Fan Kitchen	2
0.18	In Room Fan Other Wet Room	2

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	LPG Condensing system	
Percentage of Heat	100	%
Database Ref. No.	17600	
Fuel Type	Bulk LPG	
Main Heating	BLB	
SAP Code	102	
In Winter	91.8	
In Summer	81.1	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
25.0 Main Heating 2	None	

Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	Yes	
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	
SAP Code	901	

28.1 Flue Gas Heat Recovery System

Database ID	60091	
Brand Model	Baxi, Assure	
Details	Year: 2021 + current Applicable Fuel: 2 Boiler Types: RCSK Heat Store Volume: 0 PV module: 0	

29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	250.00	L
Loss	2.35	kWh/day
Pipes insulation	Fully insulated primary pipework	

31.0 Thermal Store	None

32.0 Photovoltaic Unit	One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.01	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	£70	B 85	