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

Design SAP
elmhurst energy

Property Reference	S17212	**Issued on Date**	17/10/2017
Survey Reference	Original	**Prop Type Ref**	
Property	New Dwelling, Horseshoe Lane, Chadlington, OX7 3NB		

SAP Rating	82 B	**DER**	12.55	**TER**	15.95
Environmental	87 B	**% DER<TER**	21.33		
CO_2 Emissions (t/year)	3.01	**DFEE**	61.71	**TFEE**	65.78
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.18		

Surveyor	Malcolm Lisle, Tel: 01142521995	**Surveyor ID**	8227-0002
Client			

SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (House) 17/10/2017

FullRefNo: Original

Regs Region: England
SAP Region: Thames Valley
Postcode: OX7 3NB
DwellingOrientation: North
Property Type: House, Detached
Storeys: 2
Date Built: 2017
Sheltered Sides: 2
Sunlight Shade: Average or unknown
Measurements: Perimeter, Floor Area, Storey Height
- 1st Storey: 51.6, 148.02, 2.23
- 2nd Storey: 47.2, 121.15, 3.84

Living Area: 102.66 m2, fraction: 38.1%
Thermal Mass: Precise calculation
External Walls: Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Main Cottage: 112.37, 119.72, 60, CavityWallPlasterOnDabsAACblock, Cavity, 0, 0.18, Gross
Lower Cottage: 100.75, 136.15, 60, CavityWallPlasterOnDabsAACblock, Cavity, 0, 0.18, Gross
Retaining Wall: 11.4, 12.2, 150, CavityWallPlasterOnDabsDenseBlock, Cavity, 0, 0.2, Gross
Internal Walls: Area, Kappa
Internal - Insulating Block: 430.57, 60
External Roofs: Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
- Sloping Roof: 93.18, 94.26, 9, Plasterboard, insulated slope, 0.17
- Plane Roof: 50.74, 52.9, 9, Plasterboard, insulated at ceiling level, 0.18
- Flat Roof: 64.53, 64.53, 9, Plasterboard, insulated flat roof, 0.14

Internal Ceilings: Area, Kappa, Construction, Element
- Internal Ceiling: 81.62, 18, Plasterboard ceiling, carpeted chipboard floor

Heat Loss Floors: Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
- Upper Ground Floor: 39.53, 75, Suspended concrete floor, carpeted, Ground Floor - Solid, 0, 0.13
- Lower Ground Floor: 148.02, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.12

Internal Floors: Area, Kappa, Construction, Element
- Internal Floor: 81.62, 18, Plasterboard ceiling, carpeted chipboard floor

Description: Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
- Lower Cottage Windows: Manufacturer, Window, Double Low-E Soft 0.05, , , 0.45, , 0.7,
- Main Cottage Windows: Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
- Solid Door: Manufacturer, Solid Door, , , , , , ,
- Rooflights: Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
- Glazed Doors: Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,

Openings: Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
- Windows: Window, Main Cottage, North, , None, 0, , 0, 0, 0, 1.20,
- Windows: Window, Main Cottage, East, , None, 0, , 0, 0, 0, 2.82,
- Windows: Window, Main Cottage, South, , None, 0, , 0, 0, 0, 1.44,
- Front Door: Solid Door, Main Cottage, North, , , , , 0, 0, 0, 1.89,
- Windows: Window, Lower Cottage, North, , None, 0, , 0, 0, 0, 1.32,
- Windows: Window, Lower Cottage, South, , None, 0, , 0, 0, 0, 0.90,
- Windows: Window, Lower Cottage, West, , None, 0, , 0, 0, 0, 17.68,
- Glazed Doors: Window, Lower Cottage, West, , None, 0, , 0, 0, 0, 15.50,
- Workshop Window: Window, Retaining Wall, South, , None, 0, , 0, 0, 0, 0.80,
- Rooflights: Roof Window, Sloping Roof, East, 35, None, , , 0, 0, 0, 1.08,
- Rooflights: Roof Window, Plane Roof, West, 40, None, , , 0, 0, 0, 2.16,

Conservatory: None
Draught Proofing: 100
Draught Lobby: No
Thermal Bridges
- Bridging: Calculate Bridges
- Y: 0.043
- List of Bridges: Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
- 0. External wall, E1 Steel lintel with perforated steel base plate, Independently assessed, No, 26.3, 0.05, 0.05, 1.32,
- 1. External wall, E2 Other lintels (including other steel lintels), , No, 0, 0, 0, 0.00,
- 2. External wall, E3 Sill, Table K1 - Approved, No, 18.3, 0.04, 0.04, 0.73,
- 3. External wall, E4 Jamb, Table K1 - Approved, No, 56.8, 0.05, 0.05, 2.84,
- 4. External wall, E5 Ground floor (normal), Table K1 - Approved, No, 77.7, 0.16, 0.16, 12.43,
- 5. External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
- 6. External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
- 7. External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
- 8. External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
- 9. External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, No, 21.1, 0.07, 0.07, 1.48,
- 10. External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
- 11. External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
- 12. External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
- 13. External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , , No, 0, 0, 0, 0.00,
- 14. External wall, E10 Eaves (insulation at ceiling level), Table K1 - Approved, No, 20.4, 0.06, 0.06, 1.22,
- 15. External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
- 16. External wall, E11 Eaves (insulation at rafter level), Table K1 - Approved, No, 30.9, 0.04, 0.04, 1.24,
- 17. External wall, E12 Gable (insulation at ceiling level), Table K1 - Approved, No, 9.55, 0.24, 0.24, 2.29,
- 18. External wall, E13 Gable (insulation at rafter level), Table K1 - Approved, No, 14.8, 0.04, 0.04, 0.59,
- 19. External wall, E14 Flat roof, Table K1 - Default, No, 24.2, 0.08, 0.08, 1.94,

SAP2012 - 9.92 input data (DesignData) -

20.	External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21.	External wall, E16 Corner (normal), Table K1 - Approved, No, 29.1, 0.09, 0.09, 2.62,
22.	External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 18.2, -0.09, -0.09, -1.64,
23.	External wall, E18 Party wall between dwellings, , No, 0, 0, 0, 0.00,
24.	External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25.	Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
26.	Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
27.	Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
28.	Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
29.	Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
30.	Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
31.	Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
32.	Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
33.	External roof, R1 Head of roof window, Table K1 - Default, No, 2.7, 0.08, 0.08, 0.22,
34.	External roof, R2 Sill of roof window, Table K1 - Default, No, 2.7, 0.06, 0.06, 0.16,
35.	External roof, R3 Jamb of roof window, Table K1 - Default, No, 7.2, 0.08, 0.08, 0.58,
36.	External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37.	External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38.	External roof, R6 Flat ceiling, Table K1 - Default, No, 6, 0.06, 0.06, 0.36,
39.	External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40.	External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41.	External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:	True
Designed q50:	5
AsBuilt q50:	15
Property Tested:	False
Mechanical Ventilation	None
Chimneys MHS:	0
Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	5
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	None
Light Fittings:	40
LEL Fittings:	40
Percentage of LEL Fittings:	100
External Lights Fitted:	No
External LELs Fitted:	No
Electricity Tariff:	Standard
Main Heating 1	
Description	Band A Gas Boiler
Percentage	100
Sedbuk ID	16396
Fuel Type	Mains gas
MHS	Mains gas BGB Post 98 Regular condens. with auto ign.
SAP Code	102
Boiler Efficiency Type	Split Efficiences
Efficiency Winter	90.3
Efficiency Summer	79.6
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	Yes
Ctrl SAP Code	2110
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Underfloor
Flow Temperature	Normal (> 45°C)
Under Floor Heating	Yes - Pipes in thin screed
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	
SHS	RPP - Wood Pellets (in Bags) RPP Wood pellet Stove
SAP Code	635
Hetas Approved System	True
Efficiency	65
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	
Cylinder Type	HotWaterCylinder
Cylinder Insulation Type	Foam
Cylinder Volume	300.00
Cylinder Stat	Yes
Pipeworks Insulated	Fully insulated primary pipework
Cylinder in Heated Space	Yes
Separate Time Control	Yes
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	
Type	One Dwelling
PVUnit 1	Cells Peak = 4, Orientation = East, Elevation = 45°, Overshading = Modest, , Connected to Dwelling = No
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

SAP2012 - 9.92 input data (DesignData) -

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

Detached House, total floor area 269 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
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1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.95 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.55 kgCO□/m²OK
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1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)61.7 kWh/m²/yrOK
-------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.18 (max. 0.30)        0.20 (max. 0.70)          OK
Floor           0.12 (max. 0.25)        0.13 (max. 0.70)          OK
Roof            0.16 (max. 0.20)        0.18 (max. 0.35)          OK
Openings        1.47 (max. 2.00)        1.60 (max. 3.30)          OK
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2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
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3 Air permeability
Air permeability at 50 pascals:         5.00 (design value)
Maximum                                 10.0                                            OK
-------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal Logic System 15

Efficiency: 89.3% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               Room heaters - Wood Pellets (in Bags)

Wood pellet Stove
Efficiency: 65%
Minimum: 65%                                    OK
-------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86                         OK
Primary pipework insulated:             Yes                                             OK
-------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control               OK


Hot water controls:                     Cylinderstat                                    OK
                                        Independent timer for DHW                       OK

Boiler interlock                        Yes                                             OK
-------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                             OK
-------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Not applicable
-------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Not significant                                 OK
Based on:
Overshading:                            Average
Windows facing North:                   2.52 m², No overhang
Windows facing East:                    2.82 m², No overhang
Windows facing South:                   3.14 m², No overhang
Windows facing West:                    33.18 m², No overhang
Air change rate:                        8.00 ach
Blinds/curtains:                        None
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10 Key features
Floor U-value                           0.12 W/m²K
Secondary heating (wood pellets (bags))
Secondary heating fuel:                 wood pellets (bags)
Photovoltaic array



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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	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	795.3006	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		50.0000 / (5) =	0.0629	(8)
Pressure test			Yes	
Measured/design q50			5.0000	
Infiltration rate			0.3129	(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) =	0.2659	(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	0.3391	0.3324	0.3258	0.2925	0.2859	0.2526	0.2526	0.2460	0.2659	0.2859	0.2992	0.3125	(22b)
Effective ac	0.5575	0.5553	0.5531	0.5428	0.5409	0.5319	0.5319	0.5303	0.5354	0.5409	0.5448	0.5488	(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	
Lower Cottage Windows (Uw = 1.44)			35.4000	1.3616	48.1997			(27)
Main Cottage Windows (Uw = 1.60)			6.2600	1.5038	9.4135			(27)
Solid Door			1.8900	1.4700	2.7783			(26)
Rooflights (Uw = 1.60)			3.2400	1.5038	4.8722			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389	75.0000	2964.7500	(28a)
Lower Ground Floor			148.0200	0.1200	17.7624	110.0000	16282.2000	(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266	60.0000	6742.2000	(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350	60.0000	6045.0000	(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.2000	2.2800	150.0000	1710.0000	(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1700	15.8406	9.0000	838.6200	(30)
Plane Roof	52.9000	2.1600	50.7400	0.1800	9.1332	9.0000	456.6600	(30)
Flat Roof	64.5300		64.5300	0.1400	9.0342	9.0000	580.7700	(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	162.8146			(33)
Internal - Insulating Block			430.5700			60.0000	25834.2000	(32c)
Internal Floor			81.6200			18.0000	1469.1600	(32d)
Internal Ceiling			81.6200			18.0000	1469.1600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	64392.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		239.2270 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		28.3710 (36)
Total fabric heat loss	(33) + (36) =	191.1856 (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	146.3115	145.7256	145.1514	142.4542	141.9496	139.6004	139.6004	139.1654	140.5053	141.9496	142.9704	144.0377	(38)
Heat transfer coeff	337.4971	336.9112	336.3370	333.6398	333.1352	330.7860	330.7860	330.3510	331.6909	333.1352	334.1561	335.2233	(39)
Average = Sum(39)m / 12 =												333.6374	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2538	1.2517	1.2495	1.2395	1.2376	1.2289	1.2289	1.2273	1.2323	1.2376	1.2414	1.2454	(40)
HLP (average)												1.2395	(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	3.0919 (42)
Average daily hot water use (litres/day)	107.6315 (43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3364	23.0340	23.7690	20.7224	19.8836	17.1580	15.8994	18.2448	18.4628	21.5166	23.4870	25.5054	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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													
	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(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													
	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
								Total per year (kWh/year) = Sum(64)m =				2470.4572	(64)
Heat gains from water heating, kWh/month													
	111.1720	98.7427	105.4810	97.0247	96.8684	89.1238	88.0369	93.2359	92.0159	100.4881	103.1530	109.3300	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8248	35.3721	28.7665	21.7781	16.2794	13.7437	14.8506	19.3034	25.9089	32.8973	38.3960	40.9317	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	432.7918	437.2829	425.9656	401.8726	371.4594	342.8753	323.7794	319.2884	330.6056	354.6987	385.1118	413.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	(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)													
	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	(71)
Water heating gains (Table 5)													
	149.4248	146.9385	141.7755	134.7565	130.1995	123.7830	118.3291	125.3170	127.7998	135.0647	143.2680	146.9489	(72)
Total internal gains													
	694.4192	691.9712	668.8854	630.7849	590.3160	552.7798	529.3369	536.2865	556.6921	595.0385	639.1536	673.9543	(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	1.3200	10.6334	0.4500	0.7000	0.7700	3.0640	(74)
South	0.9000	46.7521	0.4500	0.7000	0.7700	9.1852	(78)
West	33.1800	19.6403	0.4500	0.7000	0.7700	142.2550	(80)
North	1.2000	10.6334	0.6300	0.7000	0.7700	3.8996	(74)
East	2.8200	19.6403	0.6300	0.7000	0.7700	16.9265	(76)
South	2.2400	46.7521	0.6300	0.7000	0.7700	32.0052	(78)
East	1.0800	26.4634	0.6300	0.7000	1.0000	11.3436	(82)
West	2.1600	26.2379	0.6300	0.7000	1.0000	22.4939	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	241.1730	460.1608	737.9355	1058.7091	1290.6958	1320.2946	1257.2328	1082.9637	851.3358	539.9819	298.4095	199.9222	(83)
Total gains	935.5923	1152.1320	1406.8210	1689.4941	1881.0119	1873.0744	1786.5697	1619.2502	1408.0279	1135.0204	937.5631	873.8765	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	52.9986	53.0907	53.1814	53.6113	53.6925	54.0738	54.0738	54.1450	53.9263	53.6925	53.5285	53.3581	
alpha	4.5332	4.5394	4.5454	4.5741	4.5795	4.6049	4.6049	4.6097	4.5951	4.5795	4.5686	4.5572	
util living area													
	0.9998	0.9993	0.9975	0.9891	0.9574	0.8679	0.7287	0.7947	0.9558	0.9959	0.9995	0.9998	(86)
MIT	19.6912	19.8045	20.0167	20.3104	20.5951	20.8100	20.9001	20.8790	20.6895	20.3187	19.9532	19.6743	(87)
Th 2	19.8772	19.8789	19.8806	19.8885	19.8900	19.8969	19.8969	19.8982	19.8943	19.8900	19.8870	19.8839	(88)
util rest of house													
	0.9997	0.9991	0.9965	0.9842	0.9353	0.7931	0.5843	0.6629	0.9224	0.9936	0.9992	0.9998	(89)
MIT 2	18.1076	18.2748	18.5865	19.0200	19.4251	19.7065	19.7925	19.7799	19.5644	19.0355	18.4988	18.0880	(90)
Living area fraction									fLA = Living area / (4) =			0.3814	(91)
MIT	18.7116	18.8582	19.1319	19.5122	19.8713	20.1274	20.2149	20.1991	19.9935	19.5249	19.0535	18.6930	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5616	18.7082	18.9819	19.3622	19.7213	19.9774	20.0649	20.0491	19.8435	19.3749	18.9035	18.5430	(93)

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8. Space heating requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9987	0.9954	0.9810	0.9309	0.7997	0.6091	0.6841	0.9203	0.9919	0.9989	0.9997	(94)
Useful gains	935.1430	1150.5954	1400.3084	1657.3885	1751.1279	1497.9445	1088.1201	1107.7777	1295.7744	1125.8529	936.5546	873.5747	(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	4813.2428	4652.1467	4198.1370	3490.5912	2672.1772	1778.7556	1146.1453	1205.4868	1905.0613	2923.2295	3944.2255	4808.1087	(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	2885.3063	2353.0425	2081.5845	1319.9059	685.2607	0.0000	0.0000	0.0000	0.0000	1337.2482	2165.5231	2927.2933	(98)
Space heating												15755.1644	(98)
Space heating per m2											(98) / (4) =	58.5324	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	90.3000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	15702.8217	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2885.3063	2353.0425	2081.5845	1319.9059	685.2607	0.0000	0.0000	0.0000	0.0000	1337.2482	2165.5231	2927.2933	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	2875.7205	2345.2251	2074.6690	1315.5209	682.9841	0.0000	0.0000	0.0000	0.0000	1332.8055	2158.3286	2917.5681	(211)
Water heating requirement	443.8933	362.0065	320.2438	203.0625	105.4247	0.0000	0.0000	0.0000	0.0000	205.7305	333.1574	450.3528	(215)
Water heating													
Water heating requirement	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
Efficiency of water heater												79.6000	(216)
(217)m	89.2786	89.2034	89.0197	88.5696	87.4376	79.6000	79.6000	79.6000	79.6000	88.5360	89.0832	89.3129	(217)
Fuel for water heating, kWh/month	270.5767	238.9649	252.1365	228.0824	227.0748	223.9316	216.0650	235.7082	234.8588	236.5537	247.4570	264.2700	(219)
Water heating fuel used												2875.6797	(219)
Annual totals kWh/year													
Space heating fuel - main system												15702.8217	(211)
Space heating fuel - secondary												2423.8715	(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)												703.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 4.00 * 853 * 0.80) =												-2183.7566	(233)
Total delivered energy for all uses												19596.9350	(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	15702.8217	0.2160	3391.8095	(261)
Space heating - secondary	2423.8715	0.0390	94.5310	(263)
Water heating (other fuel)	2875.6797	0.2160	621.1468	(264)
Space and water heating			4107.4873	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	703.3187	0.5190	365.0224	(268)
Energy saving/generation technologies				
PV Unit	-2183.7566	0.5190	-1133.3697	(269)
Total CO2, kg/year			3378.0650	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5500	(273)

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

DER		12.5500	ZC1
Total Floor Area	TFA	269.1700	
Assumed number of occupants	N	3.0919	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		9.5279	ZC2
CO2 emissions from cooking, equation (L16)		0.7178	ZC3
Total CO2 emissions		22.7957	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		22.7957	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	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3003	(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) =	0.2553	(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	0.3254	0.3191	0.3127	0.2808	0.2744	0.2425	0.2425	0.2361	0.2553	0.2744	0.2872	0.2999	(22b)
Effective ac	0.5530	0.5509	0.5489	0.5394	0.5376	0.5294	0.5294	0.5279	0.5326	0.5376	0.5412	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			41.6600	1.3258	55.2311			(27)
TER Room Window (Uw = 1.70)			3.2400	1.5918	5.1573			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389			(28a)
Lower Ground Floor			148.0200	0.1300	19.2426			(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266			(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350			(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.1800	2.0520			(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1300	12.1134			(30)
Plane Roof	52.9000	2.1600	50.7400	0.1300	6.5962			(30)
Flat Roof	64.5300		64.5300	0.1300	8.3889			(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	154.1720			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	25.9500	(36)
Total fabric heat loss (33) + (36) =	180.1220	(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	145.1232	144.5835	144.0545	141.5697	141.1048	138.9407	138.9407	138.5399	139.7743	141.1048	142.0453	143.0285	(38)
Heat transfer coeff	325.2452	324.7055	324.1764	321.6917	321.2268	319.0627	319.0627	318.6619	319.8963	321.2268	322.1673	323.1505	(39)
Average = Sum(39)m / 12 =												321.6895	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2083	1.2063	1.2044	1.1951	1.1934	1.1854	1.1854	1.1839	1.1885	1.1934	1.1969	1.2005	(40)
HLP (average)												1.1951	(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	3.0919 (42)
Average daily hot water use (litres/day)	107.6315 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
              26.3364    23.0340    23.7690    20.7224    19.8836    17.1580    15.8994    18.2448    18.4628    21.5166    23.4870    25.5054 (46)
Water storage loss:
Store volume                                                                                                                            300.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                             2.1127 (48)
  Temperature factor from Table 2b                                                                                                        0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                1.1409 (55)
Total storage loss
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (56)
If cylinder contains dedicated solar storage
              35.3664    31.9439    35.3664    34.2256    35.3664    34.2256    35.3664    35.3664    34.2256    35.3664    34.2256    35.3664 (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
             234.2046   206.5148   217.0887   194.8867   191.1862   171.1245   164.6251   180.2611   179.8226   202.0725   213.3176   228.6646 (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
             234.2046   206.5148   217.0887   194.8867   191.1862   171.1245   164.6251   180.2611   179.8226   202.0725   213.3176   228.6646 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   2383.7690 (64)
Heat gains from water heating, kWh/month
             105.2820    93.4226    99.5910    91.3246    90.9784    83.4237    82.1468    87.3458    86.3158    94.5981    97.4529   103.4399 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m       154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925   154.5925 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              39.8248    35.3721    28.7665    21.7781    16.2794    13.7437    14.8506    19.3034    25.9089    32.8973    38.3960    40.9317 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             432.7918   437.2829   425.9656   401.8726   371.4594   342.8753   323.7794   319.2884   330.6056   354.6987   385.1118   413.6959 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593    38.4593 (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)
            -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740  -123.6740 (71)
Water heating gains (Table 5)
             141.5081   139.0218   133.8588   126.8398   122.2828   115.8663   110.4124   117.4003   119.8831   127.1480   135.3513   139.0322 (72)
Total internal gains
             686.5025   684.0545   660.9687   622.8682   582.3993   544.8631   521.4202   528.3698   548.7754   587.1217   631.2369   666.0375 (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	2.5200	10.6334	0.6300	0.7000	0.7700	8.1893	(74)
East	2.8200	19.6403	0.6300	0.7000	0.7700	16.9265	(76)
South	3.1400	46.7521	0.6300	0.7000	0.7700	44.8644	(78)
West	33.1800	19.6403	0.6300	0.7000	0.7700	199.1570	(80)
East	1.0800	26.4634	0.6300	0.7000	1.0000	11.3436	(82)
West	2.1600	26.2379	0.6300	0.7000	1.0000	22.4939	(82)

```
Solar gains   302.9747   579.8325   932.8959  1341.1198  1635.9883  1673.6128  1593.6538  1372.3316  1077.3314   681.3416   375.2265   250.9121 (83)
Total gains   989.4772  1263.8870  1593.8646  1963.9880  2218.3876  2218.4759  2115.0739  1900.7014  1626.1068  1268.4633  1006.4634   916.9496 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                               21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau          57.4716    57.5671    57.6611    58.1064    58.1905    58.5852    58.5852    58.6589    58.4326    58.1905    58.0207    57.8441
alpha         4.8314     4.8378     4.8441     4.8738     4.8794     4.9057     4.9057     4.9106     4.8955     4.8794     4.8680     4.8563
util living area
               0.9998     0.9992     0.9965     0.9820     0.9271     0.7945     0.6309     0.7084     0.9294     0.9945     0.9995     0.9999 (86)

MIT           19.4663    19.6307    19.9247    20.3204    20.6778    20.9031    20.9759    20.9586    20.7588    20.2802    19.7988    19.4400 (87)
Th 2          19.9133    19.9149    19.9165    19.9239    19.9253    19.9317    19.9317    19.9329    19.9292    19.9253    19.9225    19.9196 (88)
util rest of house
               0.9997     0.9989     0.9951     0.9742     0.8936     0.7054     0.4939     0.5730     0.8818     0.9912     0.9992     0.9998 (89)
MIT 2         17.8457    18.0874    18.5182    19.0962    19.5907    19.8626    19.9224    19.9143    19.7106    19.0440    18.3389    17.8115 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.3814 (91)
MIT           18.4638    18.6760    19.0547    19.5631    20.0053    20.2594    20.3242    20.3126    20.1104    19.5155    18.8957    18.4326 (92)
Temperature adjustment                                                                                                            0.0000
adjusted MIT  18.4638    18.6760    19.0547    19.5631    20.0053    20.2594    20.3242    20.3126    20.1104    19.5155    18.8957    18.4326 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9995     0.9984     0.9935     0.9707     0.8966     0.7355     0.5468     0.6249     0.8918     0.9894     0.9989     0.9997 (94)
Useful gains 989.0168  1261.8812  1583.4833  1906.3897  1988.9100  1631.7629  1156.4296  1187.8149  1450.1061  1255.0633  1005.3140   916.6581 (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
            4606.7102  4473.1383  4069.9290  3430.2222  2667.8898  1805.7108  1188.2556  1246.7900  1922.7053  2863.8892  3800.1821  4599.2863 (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
            2691.5639  2157.9647  1849.9155  1097.1594   505.1610     0.0000     0.0000     0.0000     0.0000  1196.9665  2012.3050  2739.8754 (98)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Space heating                                                                                                  14250.9114 (98)
Space heating per m2                                                                    (98) / (4) =            52.9439 (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 %)                                                                  93.5000 (206)
Efficiency of secondary/supplementary heating system, %                                                            0.0000 (208)
Space heating requirement                                                                                      15241.6164 (211)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Space heating requirement
             2691.5639  2157.9647  1849.9155  1097.1594   505.1610     0.0000     0.0000     0.0000     0.0000  1196.9665  2012.3050  2739.8754 (98)
Space heating efficiency (main heating system 1)
               93.5000    93.5000    93.5000    93.5000    93.5000     0.0000     0.0000     0.0000     0.0000    93.5000    93.5000    93.5000 (210)
Space heating fuel (main heating system)
             2878.6779  2307.9837  1978.5193  1173.4325   540.2791     0.0000     0.0000     0.0000     0.0000  1280.1780  2152.1979  2930.3480 (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
              234.2046   206.5148   217.0887   194.8867   191.1862   171.1245   164.6251   180.2611   179.8226   202.0725   213.3176   228.6646 (64)
Efficiency of water heater                                                                                                                  79.8000 (216)
(217)m         89.5389    89.4524    89.2432    88.7059    87.2866    79.8000    79.8000    79.8000    79.8000    88.7806    89.3517    89.5748 (217)
Fuel for water heating, kWh/month
              261.5673   230.8655   243.2550   219.6997   219.0326   214.4417   206.2972   225.8912   225.3416   227.6089   238.7393   255.2777 (219)
Water heating fuel used                                                                                                                   2768.0177 (219)
Annual totals kWh/year
Space heating fuel - main system                                                                                                         15241.6164 (211)
Space heating fuel - secondary                                                                                                               0.0000 (215)

Electricity for pumps and fans:
   central heating pump                                                                                                                     30.0000 (230c)
   main heating flue fan                                                                                                                    45.0000 (230e)
Total electricity for the above, kWh/year                                                                                                   75.0000 (231)
Electricity for lighting (calculated in Appendix L)                                                                                        703.3187 (232)
Total delivered energy for all uses                                                                                                      18787.9528 (238)


--------------------------------------------------------------------------------------------------------------------------
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
--------------------------------------------------------------------------------------------------------------------------
                                                                                Energy          Emission factor          Emissions
                                                                               kWh/year              kg CO2/kWh          kg CO2/year
Space heating - main system 1                                               15241.6164                  0.2160       3292.1892 (261)
Space heating - secondary                                                       0.0000                  0.0000          0.0000 (263)
Water heating (other fuel)                                                   2768.0177                  0.2160        597.8918 (264)
Space and water heating                                                                                               3890.0810 (265)
Pumps and fans                                                                 75.0000                  0.5190         38.9250 (267)
Energy for lighting                                                           703.3187                  0.5190        365.0224 (268)
Total CO2, kg/m2/year                                                                                                 4294.0284 (272)
Emissions per m2 for space and water heating                                                                            14.4521 (272a)
Fuel factor (mains gas)                                                                                                  1.0000
Emissions per m2 for lighting                                                                                            1.3561 (272b)
Emissions per m2 for pumps and fans                                                                                      0.1446 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4521 * 1.00) + 1.3561 + 0.1446, rounded to 2 d.p.                       15.9500 (273)


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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	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.0503 (8)
Pressure test				Yes
Measured/design q50				5.0000
Infiltration rate				0.3003 (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) =	0.2553 (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	0.3254	0.3191	0.3127	0.2808	0.2744	0.2425	0.2425	0.2361	0.2553	0.2744	0.2872	0.2999	(22b)
Effective ac	0.5530	0.5509	0.5489	0.5394	0.5376	0.5294	0.5294	0.5279	0.5326	0.5376	0.5412	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Lower Cottage Windows (Uw = 1.44)			35.4000	1.3616	48.1997			(27)
Main Cottage Windows (Uw = 1.60)			6.2600	1.5038	9.4135			(27)
Solid Door			1.8900	1.4700	2.7783			(26)
Rooflights (Uw = 1.60)			3.2400	1.5038	4.8722			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389	75.0000	2964.7500	(28a)
Lower Ground Floor			148.0200	0.1200	17.7624	110.0000	16282.2000	(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266	60.0000	6742.2000	(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350	60.0000	6045.0000	(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.2000	2.2800	150.0000	1710.0000	(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1700	15.8406	9.0000	838.6200	(30)
Plane Roof	52.9000	2.1600	50.7400	0.1800	9.1332	9.0000	456.6600	(30)
Flat Roof	64.5300		64.5300	0.1400	9.0342	9.0000	580.7700	(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	162.8146			(33)
Internal - Insulating Block			430.5700			60.0000	25834.2000	(32c)
Internal Floor			81.6200			18.0000	1469.1600	(32d)
Internal Ceiling			81.6200			9.0000	734.5800	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			63658.1400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							236.4979	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							28.3710	(36)
Total fabric heat loss					(33) + (36) =		191.1856	(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	145.1232	144.5835	144.0545	141.5697	141.1048	138.9407	138.9407	138.5399	139.7743	141.1048	142.0453	143.0285	(38)
Heat transfer coeff	336.3088	335.7691	335.2401	332.7553	332.2905	330.1263	330.1263	329.7255	330.9599	332.2905	333.2309	334.2141	(39)
Average = Sum(39)m / 12 =												332.7531	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2494	1.2474	1.2455	1.2362	1.2345	1.2265	1.2265	1.2250	1.2296	1.2345	1.2380	1.2416	(40)
HLP (average)												1.2362	(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	3.0919	(42)
Average daily hot water use (litres/day)	107.6315	(43)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	37.3099	32.6314	33.6727	29.3567	28.1684	24.3072	22.5242	25.8469	26.1556	30.4818	33.2733	36.1326	(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	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	154.5925	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8248	35.3721	28.7665	21.7781	16.2794	13.7437	14.8506	19.3034	25.9089	32.8973	38.3960	40.9317	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	432.7918	437.2829	425.9656	401.8726	371.4594	342.8753	323.7794	319.2884	330.6056	354.6987	385.1118	413.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	38.4593	(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)													
	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	(71)
Water heating gains (Table 5)													
	50.1477	48.5587	45.2590	40.7732	37.8608	33.7600	30.2745	34.7404	36.3272	40.9701	46.2129	48.5653	(72)
Total internal gains													
	592.1421	590.5914	569.3689	533.8016	494.9774	459.7569	438.2822	442.7099	462.2195	497.9439	539.0985	572.5707	(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	1.3200	10.6334	0.4500	0.7000	0.7700	3.0640	(74)
South	0.9000	46.7521	0.4500	0.7000	0.7700	9.1852	(78)
West	33.1800	19.6403	0.4500	0.7000	0.7700	142.2550	(80)
North	1.2000	10.6334	0.6300	0.7000	0.7700	3.8996	(74)
East	2.8200	19.6403	0.6300	0.7000	0.7700	16.9265	(76)
South	2.2400	46.7521	0.6300	0.7000	0.7700	32.0052	(78)
East	1.0800	26.4634	0.6300	0.7000	1.0000	11.3436	(82)
West	2.1600	26.2379	0.6300	0.7000	1.0000	22.4939	(82)

Solar gains	241.1730	460.1608	737.9355	1058.7091	1290.6958	1320.2946	1257.2328	1082.9637	851.3358	539.9819	298.4095	199.9222	(83)
Total gains	833.3151	1050.7521	1307.3045	1592.5107	1785.6732	1780.0514	1695.5150	1525.6736	1313.5553	1037.9258	837.5079	772.4929	(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	52.5791	52.6636	52.7467	53.1406	53.2149	53.5638	53.5638	53.6289	53.4289	53.2149	53.0648	52.9086	
alpha	4.5053	4.5109	4.5164	4.5427	4.5477	4.5709	4.5709	4.5753	4.5619	4.5477	4.5377	4.5272	
util living area													
	0.9998	0.9995	0.9981	0.9910	0.9634	0.8830	0.7519	0.8182	0.9643	0.9971	0.9997	0.9999	(86)
MIT	19.2890	19.4414	19.7270	20.1221	20.5086	20.8056	20.9361	20.9036	20.6349	20.1316	19.6397	19.2653	(87)
Th 2	19.8807	19.8822	19.8838	19.8911	19.8925	19.8989	19.8989	19.9001	19.8964	19.8925	19.8897	19.8868	(88)
util rest of house													
	0.9998	0.9993	0.9973	0.9869	0.9440	0.8133	0.6091	0.6913	0.9362	0.9953	0.9995	0.9999	(89)
MIT 2	18.3043	18.4579	18.7444	19.1432	19.5207	19.7905	19.8787	19.8644	19.6492	19.1555	18.6620	18.2854	(90)
Living area fraction									fLA = Living area / (4) =			0.3814	(91)
MIT	18.6799	18.8330	19.1191	19.5166	19.8975	20.1777	20.2820	20.2607	20.0251	19.5278	19.0349	18.6592	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6799	18.8330	19.1191	19.5166	19.8975	20.1777	20.2820	20.2607	20.0251	19.5278	19.0349	18.6592	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9997	0.9991	0.9966	0.9851	0.9442	0.8341	0.6643	0.7394	0.9405	0.9945	0.9993	0.9998	(94)
Useful gains	833.0650	1049.7851	1302.8058	1568.7861	1685.9550	1484.7388	1126.3994	1128.1135	1235.4372	1032.2204	836.9452	772.3317	(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													
	4836.0865	4678.2611	4230.4419	3532.7245	2723.9403	1841.3426	1215.5215	1272.9765	1960.9776	2966.6061	3977.0813	4832.4554	(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													
	2978.2480	2438.3359	2178.1612	1414.0356	772.2610	0.0000	0.0000	0.0000	0.0000	1439.1830	2260.8980	3020.7321	(98)
Space heating												16501.8548	(98)
Space heating per m2											(98) / (4) =	61.3064	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	3103.1873	2442.9347	2505.9141	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6593	0.7538	0.6958	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2045.8211	1841.5305	1743.6448	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2202.3502	2101.5070	1912.6955	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	112.7010	193.4225	125.7737	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												431.8972	(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	28.1752	48.3556	31.4434	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												107.9743	(107)
Space cooling per m2												0.4011	(108)
Energy for space heating												61.3064	(99)
Energy for space cooling												0.4011	(108)
Total												61.7076	(109)
Dwelling Fabric Energy Efficiency (DFEE)												61.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3003	(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) =	0.2553	(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	0.3254	0.3191	0.3127	0.2808	0.2744	0.2425	0.2425	0.2361	0.2553	0.2744	0.2872	0.2999	(22b)
Effective ac	0.5530	0.5509	0.5489	0.5394	0.5376	0.5294	0.5294	0.5279	0.5326	0.5376	0.5412	0.5450	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			41.6600	1.3258	55.2311			(27)
TER Room Window (Uw = 1.70)			3.2400	1.5918	5.1573			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389			(28a)
Lower Ground Floor			148.0200	0.1300	19.2426			(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266			(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350			(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.1800	2.0520			(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1300	12.1134			(30)
Plane Roof	52.9000	2.1600	50.7400	0.1300	6.5962			(30)
Flat Roof	64.5300		64.5300	0.1300	8.3889			(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		154.1720			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	25.9500	(36)
Total fabric heat loss (33) + (36) =	180.1220	(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	145.1232	144.5835	144.0545	141.5697	141.1048	138.9407	138.9407	138.5399	139.7743	141.1048	142.0453	143.0285	(38)
Heat transfer coeff	325.2452	324.7055	324.1764	321.6917	321.2268	319.0627	319.0627	318.6619	319.8963	321.2268	322.1673	323.1505	(39)
Average = Sum(39)m / 12 =												321.6895	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2083	1.2063	1.2044	1.1951	1.1934	1.1854	1.1854	1.1839	1.1885	1.1934	1.1969	1.2005	(40)
HLP (average)												1.1951	(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	3.0919 (42)
Average daily hot water use (litres/day)	107.6315 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (46)
Water storage loss:
Total storage loss
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Primary loss   0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (59)
Heat gains from water heating, kWh/month
              37.3099   32.6314   33.6727   29.3567   28.1684   24.3072   22.5242   25.8469   26.1556   30.4818   33.2733   36.1326 (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        154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925  154.5925 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              39.8248   35.3721   28.7665   21.7781   16.2794   13.7437   14.8506   19.3034   25.9089   32.8973   38.3960   40.9317 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             432.7918  437.2829  425.9656  401.8726  371.4594  342.8753  323.7794  319.2884  330.6056  354.6987  385.1118  413.6959 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593   38.4593 (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)
            -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 -123.6740 (71)
Water heating gains (Table 5)
              50.1477   48.5587   45.2590   40.7732   37.8608   33.7600   30.2745   34.7404   36.3272   40.9701   46.2129   48.5653 (72)
Total internal gains
             592.1421  590.5914  569.3689  533.8016  494.9774  459.7569  438.2822  442.7099  462.2195  497.9439  539.0985  572.5707 (73)


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6. Solar gains
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[Jan]                                  Area          Solar flux              g                FF            Access            Gains
                                       m2             Table 6a      Specific data    Specific data        factor                W
                                                         W/m2      or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------
North                                 2.5200            10.6334           0.6300           0.7000           0.7700            8.1893 (74)
East                                  2.8200            19.6403           0.6300           0.7000           0.7700           16.9265 (76)
South                                 3.1400            46.7521           0.6300           0.7000           0.7700           44.8644 (78)
West                                 33.1800            19.6403           0.6300           0.7000           0.7700          199.1570 (80)
East                                  1.0800            26.4634           0.6300           0.7000           1.0000           11.3436 (82)
West                                  2.1600            26.2379           0.6300           0.7000           1.0000           22.4939 (82)
-------------------------------------------------------------------------------------------------------------

Solar gains    302.9747  579.8325  932.8959 1341.1198 1635.9883 1673.6128 1593.6538 1372.3316 1077.3314  681.3416  375.2265  250.9121 (83)
Total gains    895.1168 1170.4239 1502.2648 1874.9214 2130.9656 2133.3697 2031.9360 1815.0415 1539.5509 1179.2855  914.3250  823.4828 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau          57.4716   57.5671   57.6611   58.1064   58.1905   58.5852   58.5852   58.6589   58.4326   58.1905   58.0207   57.8441
alpha         4.8314    4.8378    4.8441    4.8738    4.8794    4.9057    4.9057    4.9106    4.8955    4.8794    4.8680    4.8563
util living area
               0.9999    0.9994    0.9973    0.9851    0.9361    0.8120    0.6517    0.7317    0.9411    0.9960    0.9997    0.9999 (86)

MIT           19.4338   19.5985   19.8936   20.2921   20.6564   20.8926   20.9724   20.9522   20.7372   20.2501   19.7670   19.4077 (87)
Th 2          19.9133   19.9149   19.9165   19.9239   19.9253   19.9317   19.9317   19.9329   19.9292   19.9253   19.9225   19.9196 (88)
util rest of house
               0.9998    0.9992    0.9962    0.9784    0.9056    0.7252    0.5125    0.5963    0.8992    0.9936    0.9995    0.9999 (89)
MIT 2         18.4691   18.6350   18.9309   19.3315   19.6787   19.8784   19.9242   19.9178   19.7628   19.2939   18.8095   18.4480 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.3814 (91)
MIT           18.8370   19.0025   19.2981   19.6979   20.0516   20.2652   20.3240   20.3123   20.1344   19.6586   19.1747   18.8141 (92)
Temperature adjustment                                                                                               0.0000
adjusted MIT  18.8370   19.0025   19.2981   19.6979   20.0516   20.2652   20.3240   20.3123   20.1344   19.6586   19.1747   18.8141 (93)


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

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9997    0.9990    0.9953    0.9766    0.9098    0.7553    0.5665    0.6487    0.9092    0.9927    0.9993    0.9998 (94)
Useful gains 894.8831 1169.2376 1495.2576 1831.0113 1938.8525 1611.4084 1151.1448 1177.4696 1399.7284 1170.6927  913.7175  823.3419 (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
            4728.1007 4579.1611 4148.8374 3473.5794 2682.7419 1807.5529 1188.1874 1246.7164 1930.3926 2909.8669 3890.0671 4722.5375 (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
            2851.9138 2291.4686 1974.2634 1182.6490  553.4537    0.0000    0.0000    0.0000    0.0000 1293.9456 2142.9717 2901.0015 (98)
Space heating                                                                                                    15191.6673 (98)
Space heating per m2                                                                                 (98) / (4) =     56.4389 (99)


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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
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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2999.1890	2361.0637	2421.8304	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7692	0.8527	0.7990	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2307.0524	2013.2712	1935.1228	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2615.3196	2494.7263	2250.9177	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	221.9524	358.2026	234.9515	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												815.1065	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	55.4881	89.5507	58.7379	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												203.7766	(107)
Space cooling per m2												0.7571	(108)
Energy for space heating												56.4389	(99)
Energy for space cooling												0.7571	(108)
Total												57.1960	(109)
Target Fabric Energy Efficiency (TFEE)												65.8	(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	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.0629	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3129	(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) =	0.2659	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.0000	4.6000	4.4000	3.9000	3.9000	3.9000	4.2000	4.5000	4.6000	4.9000	(22)
Wind factor	1.3500	1.2750	1.2500	1.1500	1.1000	0.9750	0.9750	0.9750	1.0500	1.1250	1.1500	1.2250	(22a)
Adj infilt rate	0.3590	0.3391	0.3324	0.3058	0.2925	0.2593	0.2593	0.2593	0.2792	0.2992	0.3058	0.3258	(22b)
Effective ac	0.5644	0.5575	0.5553	0.5468	0.5428	0.5336	0.5336	0.5336	0.5390	0.5448	0.5468	0.5531	(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	
Lower Cottage Windows (Uw = 1.44)			35.4000	1.3616	48.1997			(27)
Main Cottage Windows (Uw = 1.60)			6.2600	1.5038	9.4135			(27)
Solid Door			1.8900	1.4700	2.7783			(26)
Rooflights (Uw = 1.60)			3.2400	1.5038	4.8722			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389	75.0000	2964.7500	(28a)
Lower Ground Floor			148.0200	0.1200	17.7624	110.0000	16282.2000	(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266	60.0000	6742.2000	(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350	60.0000	6045.0000	(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.2000	2.2800	150.0000	1710.0000	(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1700	15.8406	9.0000	838.6200	(30)
Plane Roof	52.9000	2.1600	50.7400	0.1800	9.1332	9.0000	456.6600	(30)
Flat Roof	64.5300		64.5300	0.1400	9.0342	9.0000	580.7700	(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		162.8146			(33)
Internal - Insulating Block			430.5700			60.0000	25834.2000	(32c)
Internal Floor			81.6200			18.0000	1469.1600	(32d)
Internal Ceiling			81.6200			18.0000	1469.1600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	64392.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		239.2270 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		28.3710 (36)
Total fabric heat loss	(33) + (36) =	191.1856 (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	148.1386	146.3115	145.7256	143.4983	142.4542	140.0470	140.0470	140.0470	141.4565	142.9704	143.4983	145.1514	(38)
Heat transfer coeff	339.3242	337.4971	336.9112	334.6839	333.6398	331.2326	331.2326	331.2326	332.6421	334.1561	334.6839	336.3370	(39)
Average = Sum(39)m / 12 =												334.4644	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2606	1.2538	1.2517	1.2434	1.2395	1.2306	1.2306	1.2306	1.2358	1.2414	1.2434	1.2495	(40)
HLP (average)												1.2426	(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	3.0919 (42)
Average daily hot water use (litres/day)	107.6315 (43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)
Distribution loss (46)m = 0.15 x (45)m	26.3364	23.0340	23.7690	20.7224	19.8836	17.1580	15.8994	18.2448	18.4628	21.5166	23.4870	25.5054	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(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	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
								Total per year (kWh/year) = Sum(64)m =				2470.4572	(64)
RHI water heating demand												2470	(64)
Heat gains from water heating, kWh/month	111.1720	98.7427	105.4810	97.0247	96.8684	89.1238	88.0369	93.2359	92.0159	100.4881	103.1530	109.3300	(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	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.5620	88.4301	71.9162	54.4452	40.6984	34.3593	37.1265	48.2584	64.7723	82.2433	95.9901	102.3292	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	645.9580	652.6610	635.7696	599.8098	554.4170	511.7542	483.2528	476.5498	493.4412	529.4010	574.7938	617.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	(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)	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	(71)
Water heating gains (Table 5)	149.4248	146.9385	141.7755	134.7565	130.1995	123.7830	118.3291	125.3170	127.7998	135.0647	143.2680	146.9489	(72)
Total internal gains	1016.4248	1009.5096	970.9413	910.4915	846.7949	791.3765	760.1884	771.6052	807.4933	868.1890	935.5318	988.2147	(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	1.3200	12.8263	0.4500	0.7000	0.7700	3.6959	(74)
South	0.9000	54.8726	0.4500	0.7000	0.7700	10.7806	(78)
West	33.1800	23.8751	0.4500	0.7000	0.7700	172.9283	(80)
North	1.2000	12.8263	0.6300	0.7000	0.7700	4.7039	(74)
East	2.8200	23.8751	0.6300	0.7000	0.7700	20.5763	(76)
South	2.2400	54.8726	0.6300	0.7000	0.7700	37.5643	(78)
East	1.0800	32.3546	0.6300	0.7000	1.0000	13.8689	(82)
West	2.1600	32.0564	0.6300	0.7000	1.0000	27.4821	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	291.6001	494.6957	766.1358	1125.3037	1314.9063	1450.2577	1335.0509	1176.2771	929.0779	588.2556	346.5952	233.7262	(83)
Total gains	1308.0249	1504.2053	1737.0771	2035.7952	2161.7012	2241.6342	2095.2394	1947.8823	1736.5712	1456.4446	1282.1270	1221.9409	(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	52.7132	52.9986	53.0907	53.4441	53.6113	54.0009	54.0009	54.0009	53.7721	53.5285	53.4441	53.1814	
alpha	4.5142	4.5332	4.5394	4.5629	4.5741	4.6001	4.6001	4.6001	4.5848	4.5686	4.5629	4.5454	
util living area	0.9990	0.9981	0.9944	0.9786	0.9330	0.7908	0.6497	0.6977	0.9178	0.9894	0.9981	0.9993	(86)
MIT	19.7559	19.8595	20.0830	20.3840	20.6514	20.8573	20.9154	20.9060	20.7450	20.3900	20.0250	19.7446	(87)
Th 2	19.8718	19.8772	19.8789	19.8854	19.8885	19.8956	19.8956	19.8956	19.8915	19.8870	19.8854	19.8806	(88)
util rest of house	0.9987	0.9974	0.9923	0.9697	0.9019	0.6993	0.5082	0.5570	0.8667	0.9837	0.9973	0.9991	(89)
MIT 2	18.1983	18.3538	18.6814	19.1216	19.4964	19.7494	19.7989	19.7937	19.6274	19.1354	18.6024	18.1884	(90)
Living area fraction									fLA = Living area / (4) =			0.3814	(91)
MIT	18.7924	18.9280	19.2160	19.6030	19.9369	20.1719	20.2247	20.2179	20.0536	19.6139	19.1450	18.7819	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6424	18.7780	19.0660	19.4530	19.7869	20.0219	20.0747	20.0679	19.9036	19.4639	18.9950	18.6319	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9965	0.9902	0.9652	0.8983	0.7112	0.5330	0.5812	0.8675	0.9806	0.9964	0.9987	(94)
Useful gains	1305.6929	1498.9167	1720.0695	1964.9404	1941.8818	1594.2426	1116.7781	1132.1253	1506.4090	1428.1760	1277.5039	1220.3072	(95)
Ext temp.	4.0000	4.5000	6.3000	8.8000	11.7000	14.7000	16.6000	16.5000	14.0000	10.5000	6.9000	4.0000	(96)
Heat loss rate W													
	4968.5161	4818.7999	4300.9972	3565.4002	2698.1192	1762.7893	1150.9374	1181.8161	1963.7963	2995.3454	4047.9915	4921.2658	(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													
	2725.1405	2230.9615	1920.2102	1152.3310	562.6406	0.0000	0.0000	0.0000	0.0000	1165.9740	1994.7510	2753.5132	(98)
Space heating												14505.5221	(98)
RHI space heating demand												14506	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							5 * 10 =	50.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.0629	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3129	(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) =	0.2659	(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	0.3391	0.3324	0.3258	0.2925	0.2859	0.2526	0.2526	0.2460	0.2659	0.2859	0.2992	0.3125	(22b)
Effective ac	0.5575	0.5553	0.5531	0.5428	0.5409	0.5319	0.5319	0.5303	0.5354	0.5409	0.5448	0.5488	(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	
Lower Cottage Windows (Uw = 1.44)			35.4000	1.3616	48.1997			(27)
Main Cottage Windows (Uw = 1.60)			6.2600	1.5038	9.4135			(27)
Solid Door			1.8900	1.4700	2.7783			(26)
Rooflights (Uw = 1.60)			3.2400	1.5038	4.8722			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389	75.0000	2964.7500	(28a)
Lower Ground Floor			148.0200	0.1200	17.7624	110.0000	16282.2000	(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266	60.0000	6742.2000	(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350	60.0000	6045.0000	(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.2000	2.2800	150.0000	1710.0000	(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1700	15.8406	9.0000	838.6200	(30)
Plane Roof	52.9000	2.1600	50.7400	0.1800	9.1332	9.0000	456.6600	(30)
Flat Roof	64.5300		64.5300	0.1400	9.0342	9.0000	580.7700	(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		162.8146			(33)
Internal - Insulating Block			430.5700			60.0000	25834.2000	(32c)
Internal Floor			81.6200			18.0000	1469.1600	(32d)
Internal Ceiling			81.6200			18.0000	1469.1600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		64392.7200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							239.2270	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							28.3710	(36)
Total fabric heat loss					(33) + (36) =		191.1856	(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	146.3115	145.7256	145.1514	142.4542	141.9496	139.6004	139.6004	139.1654	140.5053	141.9496	142.9704	144.0377	(38)
Heat transfer coeff	337.4971	336.9112	336.3370	333.6398	333.1352	330.7860	330.7860	330.3510	331.6909	333.1352	334.1561	335.2233	(39)
Average = Sum(39)m / 12 =												333.6374	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2538	1.2517	1.2495	1.2395	1.2376	1.2289	1.2289	1.2273	1.2323	1.2376	1.2414	1.2454	(40)
HLP (average)												1.2395	(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	3.0919	(42)
Average daily hot water use (litres/day)	107.6315	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.3364	23.0340	23.7690	20.7224	19.8836	17.1580	15.8994	18.2448	18.4628	21.5166	23.4870	25.5054	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage													
	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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													
	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(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													
	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
									Total per year (kWh/year) = Sum(64)m =			2470.4572	(64)
Heat gains from water heating, kWh/month													
	111.1720	98.7427	105.4810	97.0247	96.8684	89.1238	88.0369	93.2359	92.0159	100.4881	103.1530	109.3300	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	99.5620	88.4301	71.9162	54.4452	40.6984	34.3593	37.1265	48.2584	64.7723	82.2433	95.9901	102.3292	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	645.9580	652.6610	635.7696	599.8098	554.4170	511.7542	483.2528	476.5498	493.4412	529.4010	574.7938	617.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	(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)													
	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	(71)
Water heating gains (Table 5)													
	149.4248	146.9385	141.7755	134.7565	130.1995	123.7830	118.3291	125.3170	127.7998	135.0647	143.2680	146.9489	(72)
Total internal gains													
	1016.4248	1009.5096	970.9413	910.4915	846.7949	791.3765	760.1884	771.6052	807.4933	868.1890	935.5318	988.2147	(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	1.3200	10.6334	0.4500	0.7000	0.7700	3.0640	(74)
South	0.9000	46.7521	0.4500	0.7000	0.7700	9.1852	(78)
West	33.1800	19.6403	0.4500	0.7000	0.7700	142.2550	(80)
North	1.2000	10.6334	0.6300	0.7000	0.7700	3.8996	(74)
East	2.8200	19.6403	0.6300	0.7000	0.7700	16.9265	(76)
South	2.2400	46.7521	0.6300	0.7000	0.7700	32.0052	(78)
East	1.0800	26.4634	0.6300	0.7000	1.0000	11.3436	(82)
West	2.1600	26.2379	0.6300	0.7000	1.0000	22.4939	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	241.1730	460.1608	737.9355	1058.7091	1290.6958	1320.2946	1257.2328	1082.9637	851.3358	539.9819	298.4095	199.9222	(83)
Total gains	1257.5978	1469.6704	1708.8769	1969.2006	2137.4907	2111.6711	2017.4212	1854.5689	1658.8291	1408.1709	1233.9413	1188.1369	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	52.9986	53.0907	53.1814	53.6113	53.6925	54.0738	54.0738	54.1450	53.9263	53.6925	53.5285	53.3581	
alpha	4.5332	4.5394	4.5454	4.5741	4.5795	4.6049	4.6049	4.6097	4.5951	4.5795	4.5686	4.5572	
util living area													
	0.9991	0.9981	0.9945	0.9804	0.9352	0.8226	0.6682	0.7316	0.9249	0.9903	0.9983	0.9993	(86)
MIT	19.7765	19.8883	20.0954	20.3796	20.6479	20.8397	20.9125	20.8977	20.7397	20.3891	20.0317	19.7578	(87)
Th 2	19.8772	19.8789	19.8806	19.8885	19.8900	19.8969	19.8969	19.8982	19.8943	19.8900	19.8870	19.8839	(88)
util rest of house													
	0.9988	0.9974	0.9924	0.9722	0.9048	0.7375	0.5255	0.5946	0.8760	0.9850	0.9976	0.9991	(89)
MIT 2	18.2325	18.3974	18.7009	19.1182	19.4932	19.7346	19.7988	19.7914	19.6247	19.1367	18.6136	18.2102	(90)
Living area fraction									fLA = Living area / (4) =			0.3814	(91)
MIT	18.8214	18.9660	19.2328	19.5993	19.9336	20.1561	20.2236	20.2133	20.0500	19.6144	19.1544	18.8004	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6714	18.8160	19.0828	19.4493	19.7836	20.0061	20.0736	20.0633	19.9000	19.4644	19.0044	18.6504	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9964	0.9903	0.9678	0.9011	0.7473	0.5504	0.6177	0.8763	0.9821	0.9967	0.9988	(94)
Useful gains	1255.5470	1464.4513	1692.2509	1905.8106	1926.1854	1578.1052	1110.3328	1145.5172	1453.6379	1382.9665	1229.8846	1186.6532	(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	4850.2955	4688.4634	4232.0542	3519.6530	2692.9303	1788.2571	1149.0038	1210.1863	1923.7962	2953.0355	3977.9415	4844.1130	(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	2674.4929	2166.5361	1889.6137	1161.9666	570.4582	0.0000	0.0000	0.0000	0.0000	1168.1313	1978.6010	2721.1501	(98)

Space heating 14330.9499 (98)
Space heating per m2 (98) / (4) = 53.2413 (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) 0.1000 (201)
Fraction of space heat from main system(s) 0.9000 (202)
Efficiency of main space heating system 1 (in %) 90.3000 (206)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)
Space heating requirement 14283.3388 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2674.4929	2166.5361	1889.6137	1161.9666	570.4582	0.0000	0.0000	0.0000	0.0000	1168.1313	1978.6010	2721.1501	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	2665.6076	2159.3383	1883.3359	1158.1062	568.5630	0.0000	0.0000	0.0000	0.0000	1164.2505	1972.0275	2712.1097	(211)
Water heating requirement	411.4605	333.3133	290.7098	178.7641	87.7628	0.0000	0.0000	0.0000	0.0000	179.7125	304.4001	418.6385	(215)
Water heating													
Water heating requirement	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
Efficiency of water heater												79.6000	(216)
(217)m	89.2063	89.1194	88.9066	88.3767	87.0372	79.6000	79.6000	79.6000	79.6000	88.3276	88.9824	89.2455	(217)
Fuel for water heating, kWh/month	270.7960	239.1901	252.4573	228.5803	228.1194	223.9316	216.0650	235.7082	234.8588	237.1116	247.7374	264.4696	(219)

Water heating fuel used 2879.0252 (219)
Annual totals kWh/year
Space heating fuel - main system 14283.3388 (211)
Space heating fuel - secondary 2204.7615 (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) 703.3187 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 4.00 * 853 * 0.80) = -2183.7566 (233)
Total delivered energy for all uses 17961.6877 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	14283.3388	3.4800	497.0602	(240)
Space heating - secondary	2204.7615	5.8100	128.0966	(242)
Water heating (other fuel)	2879.0252	3.4800	100.1901	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	703.3187	13.1900	92.7677	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	0.0000	0.0000	0.0000	(252)
Total energy cost			948.0072	(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] = 1.2673 (257)
SAP value 82.3205
SAP rating (Section 12) 82 (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	14283.3388	0.2160	3085.2012	(261)
Space heating - secondary	2204.7615	0.0390	85.9857	(263)
Water heating (other fuel)	2879.0252	0.2160	621.8695	(264)
Space and water heating			3793.0563	(265)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	703.3187	0.5190	365.0224 (268)
Energy saving/generation technologies			
PV Unit	-2183.7566	0.5190	-1133.3697 (269)
Total kg/year			3063.6341 (272)
CO2 emissions per m2			11.3800 (273)
EI value			86.9330
EI rating			87 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9030 = 4.133, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9030 = 0.2565, stars = 4
Water heating energy efficiency	3.48 / 0.8563 = 4.064, stars = 4
Water heating environmental impact	0.216 / 0.8563 = 0.2522, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	148.0200	(1b)	x 2.2300	(2b) =	330.0846	(1b) - (3b)
First floor	121.1500	(1c)	x 3.8400	(2c) =	465.2160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	269.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		795.3006	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			50.0000 / (5) =	0.0629	(8)
Pressure test				Yes	
Measured/design q50				5.0000	
Infiltration rate				0.3129	(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) =	0.2659	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.0000	4.6000	4.4000	3.9000	3.9000	3.9000	4.2000	4.5000	4.6000	4.9000	(22)
Wind factor	1.3500	1.2750	1.2500	1.1500	1.1000	0.9750	0.9750	0.9750	1.0500	1.1250	1.1500	1.2250	(22a)
Adj infilt rate	0.3590	0.3391	0.3324	0.3058	0.2925	0.2593	0.2593	0.2593	0.2792	0.2992	0.3058	0.3258	(22b)
Effective ac	0.5644	0.5575	0.5553	0.5468	0.5428	0.5336	0.5336	0.5336	0.5390	0.5448	0.5468	0.5531	(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	
Lower Cottage Windows (Uw = 1.44)			35.4000	1.3616	48.1997			(27)
Main Cottage Windows (Uw = 1.60)			6.2600	1.5038	9.4135			(27)
Solid Door			1.8900	1.4700	2.7783			(26)
Rooflights (Uw = 1.60)			3.2400	1.5038	4.8722			(27a)
Upper Ground Floor			39.5300	0.1300	5.1389	75.0000	2964.7500	(28a)
Lower Ground Floor			148.0200	0.1200	17.7624	110.0000	16282.2000	(28a)
Main Cottage	119.7200	7.3500	112.3700	0.1800	20.2266	60.0000	6742.2000	(29a)
Lower Cottage	136.1500	35.4000	100.7500	0.1800	18.1350	60.0000	6045.0000	(29a)
Retaining Wall	12.2000	0.8000	11.4000	0.2000	2.2800	150.0000	1710.0000	(29a)
Sloping Roof	94.2600	1.0800	93.1800	0.1700	15.8406	9.0000	838.6200	(30)
Plane Roof	52.9000	2.1600	50.7400	0.1800	9.1332	9.0000	456.6600	(30)
Flat Roof	64.5300		64.5300	0.1400	9.0342	9.0000	580.7700	(30)
Total net area of external elements Aum(A, m2)			667.3100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	162.8146			(33)
Internal - Insulating Block			430.5700			60.0000	25834.2000	(32c)
Internal Floor			81.6200			18.0000	1469.1600	(32d)
Internal Ceiling			81.6200			18.0000	1469.1600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	64392.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		239.2270 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		28.3710 (36)
Total fabric heat loss	(33) + (36) =	191.1856 (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	148.1386	146.3115	145.7256	143.4983	142.4542	140.0470	140.0470	140.0470	141.4565	142.9704	143.4983	145.1514	(38)
Heat transfer coeff	339.3242	337.4971	336.9112	334.6839	333.6398	331.2326	331.2326	331.2326	332.6421	334.1561	334.6839	336.3370	(39)
Average = Sum(39)m / 12 =												334.4644	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2606	1.2538	1.2517	1.2434	1.2395	1.2306	1.2306	1.2306	1.2358	1.2414	1.2434	1.2495	(40)
HLP (average)												1.2426	(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		3.0919 (42)
Average daily hot water use (litres/day)		107.6315 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	118.3946	114.0893	109.7841	105.4788	101.1736	96.8683	96.8683	101.1736	105.4788	109.7841	114.0893	118.3946	(44)
Energy conte	175.5758	153.5597	158.4599	138.1491	132.5574	114.3869	105.9963	121.6323	123.0850	143.4437	156.5800	170.0358	(45)
Energy content (annual)										Total = Sum(45)m =		1693.4620	(45)
Distribution loss (46)m = 0.15 x (45)m	26.3364	23.0340	23.7690	20.7224	19.8836	17.1580	15.8994	18.2448	18.4628	21.5166	23.4870	25.5054	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
Total storage loss	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(56)
If cylinder contains dedicated solar storage	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(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	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(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	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
								Total per year (kWh/year) = Sum(64)m =				2470.4572	(64)
Heat gains from water heating, kWh/month	111.1720	98.7427	105.4810	97.0247	96.8684	89.1238	88.0369	93.2359	92.0159	100.4881	103.1530	109.3300	(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	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	185.5111	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.5620	88.4301	71.9162	54.4452	40.6984	34.3593	37.1265	48.2584	64.7723	82.2433	95.9901	102.3292	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	645.9580	652.6610	635.7696	599.8098	554.4170	511.7542	483.2528	476.5498	493.4412	529.4010	574.7938	617.4566	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	56.6430	(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)	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	-123.6740	(71)
Water heating gains (Table 5)	149.4248	146.9385	141.7755	134.7565	130.1995	123.7830	118.3291	125.3170	127.7998	135.0647	143.2680	146.9489	(72)
Total internal gains	1016.4248	1009.5096	970.9413	910.4915	846.7949	791.3765	760.1884	771.6052	807.4933	868.1890	935.5318	988.2147	(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	1.3200	12.8263	0.4500	0.7000	0.7700	3.6959	(74)
South	0.9000	54.8726	0.4500	0.7000	0.7700	10.7806	(78)
West	33.1800	23.8751	0.4500	0.7000	0.7700	172.9283	(80)
North	1.2000	12.8263	0.6300	0.7000	0.7700	4.7039	(74)
East	2.8200	23.8751	0.6300	0.7000	0.7700	20.5763	(76)
South	2.2400	54.8726	0.6300	0.7000	0.7700	37.5643	(78)
East	1.0800	32.3546	0.6300	0.7000	1.0000	13.8689	(82)
West	2.1600	32.0564	0.6300	0.7000	1.0000	27.4821	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	291.6001	494.6957	766.1358	1125.3037	1314.9063	1450.2577	1335.0509	1176.2771	929.0779	588.2556	346.5952	233.7262	(83)
Total gains	1308.0249	1504.2053	1737.0771	2035.7952	2161.7012	2241.6342	2095.2394	1947.8823	1736.5712	1456.4446	1282.1270	1221.9409	(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	52.7132	52.9986	53.0907	53.4441	53.6113	54.0009	54.0009	54.0009	53.7721	53.5285	53.4441	53.1814	
alpha	4.5142	4.5332	4.5394	4.5629	4.5741	4.6001	4.6001	4.6001	4.5848	4.5686	4.5629	4.5454	
util living area	0.9990	0.9981	0.9944	0.9786	0.9330	0.7908	0.6497	0.6977	0.9178	0.9894	0.9981	0.9993	(86)
MIT	19.7559	19.8595	20.0830	20.3840	20.6514	20.8573	20.9154	20.9060	20.7450	20.3900	20.0250	19.7446	(87)
Th 2	19.8718	19.8772	19.8789	19.8854	19.8885	19.8956	19.8956	19.8956	19.8915	19.8870	19.8854	19.8806	(88)
util rest of house	0.9987	0.9974	0.9923	0.9697	0.9019	0.6993	0.5082	0.5570	0.8667	0.9837	0.9973	0.9991	(89)
MIT 2	18.1983	18.3538	18.6814	19.1216	19.4964	19.7494	19.7989	19.7937	19.6274	19.1354	18.6024	18.1884	(90)
Living area fraction									fLA = Living area / (4) =			0.3814	(91)
MIT	18.7924	18.9280	19.2160	19.6030	19.9369	20.1719	20.2247	20.2179	20.0536	19.6139	19.1450	18.7819	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6424	18.7780	19.0660	19.4530	19.7869	20.0219	20.0747	20.0679	19.9036	19.4639	18.9950	18.6319	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9965	0.9902	0.9652	0.8983	0.7112	0.5330	0.5812	0.8675	0.9806	0.9964	0.9987	(94)
Useful gains	1305.6929	1498.9167	1720.0695	1964.9404	1941.8818	1594.2426	1116.7781	1132.1253	1506.4090	1428.1760	1277.5039	1220.3072	(95)
Ext temp.	4.0000	4.5000	6.3000	8.8000	11.7000	14.7000	16.6000	16.5000	14.0000	10.5000	6.9000	4.0000	(96)
Heat loss rate W	4968.5161	4818.7999	4300.9972	3565.4002	2698.1192	1762.7893	1150.9374	1181.8161	1963.7963	2995.3454	4047.9915	4921.2658	(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	2725.1405	2230.9615	1920.2102	1152.3310	562.6406	0.0000	0.0000	0.0000	0.0000	1165.9740	1994.7510	2753.5132	(98)
Space heating												14505.5221	(98)
Space heating per m2											(98) / (4) =	53.8898	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	90.3000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	14457.3310	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2725.1405	2230.9615	1920.2102	1152.3310	562.6406	0.0000	0.0000	0.0000	0.0000	1165.9740	1994.7510	2753.5132	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	2716.0868	2223.5497	1913.8308	1148.5027	560.7714	0.0000	0.0000	0.0000	0.0000	1162.1003	1988.1239	2744.3653	(211)
Water heating requirement	419.2524	343.2248	295.4170	177.2817	86.5601	0.0000	0.0000	0.0000	0.0000	179.3806	306.8848	423.6174	(215)
Water heating													
Water heating requirement	241.5672	213.1648	224.4512	202.0118	198.5488	178.2496	171.9877	187.6237	186.9476	209.4351	220.4426	236.0271	(64)
Efficiency of water heater												79.6000	(216)
(217)m	89.2246	89.1499	88.9260	88.3635	87.0059	79.6000	79.6000	79.6000	79.6000	88.3247	88.9918	89.2566	(217)
Fuel for water heating, kWh/month	270.7405	239.1084	252.4024	228.6144	228.2016	223.9316	216.0650	235.7082	234.8588	237.1196	247.7113	264.4365	(219)
Water heating fuel used												2878.8983	(219)
Annual totals kWh/year													
Space heating fuel - main system												14457.3310	(211)
Space heating fuel - secondary												2231.6188	(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)												703.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 4.00 * 922 * 0.80) =												-2361.4223	(233)
Total delivered energy for all uses												17984.7445	(238)

10a. Fuel costs - using BEDF prices (418)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	14457.3310	4.1000	592.7506	(240)
Space heating - secondary	2231.6188	6.0900	135.9056	(242)
Water heating (other fuel)	2878.8983	4.1000	118.0348	(247)
Pumps and fans for heating	75.0000	15.7000	11.7750	(249)
Energy for lighting	703.3187	15.7000	110.4210	(250)
Additional standing charges			89.0000	(251)
Energy saving/generation technologies				
PV Unit	0.0000	0.0000	0.0000	(252)
Total energy cost			1057.8870	(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	14457.3310	0.2160	3122.7835	(261)
Space heating - secondary	2231.6188	0.0390	87.0331	(263)
Water heating (other fuel)	2878.8983	0.2160	621.8420	(264)
Space and water heating			3831.6587	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	703.3187	0.5190	365.0224	(268)
Energy saving/generation technologies				
PV Unit	-2361.4223	0.5190	-1225.5782	(269)
Total kg/year			3010.0279	(272)

13a. Primary energy - Individual heating systems including micro-CHP

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	14457.3310	1.2200	17637.9438	(261)
Space heating - secondary	2231.6188	1.2600	2811.8397	(263)
Water heating (other fuel)	2878.8983	1.2200	3512.2559	(264)
Space and water heating			23962.0394	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	703.3187	3.0700	2159.1885	(268)
Energy saving/generation technologies				
PV Unit	-2361.4223	3.0700	-7249.5663	(269)
Primary energy kWh/year			19101.9115	(272)
Primary energy kWh/m2/year			70.9660	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 87

(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	SAP increase too small
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
(none)			

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 47	-266 kg (8.8%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 418 TEST (26 Sep 2017)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£122	£122	£0
Mains gas	£800	£800	£0
Wood	£136	£136	£0
Space heating	£829	£829	£0
Water heating	£118	£118	£0
Lighting	£110	£110	£0
Total cost of fuels	£1058	£1058	£0
Total cost of uses	£1057	£1057	£0
Delivered energy	67 kWh/m²	67 kWh/m²	0 kWh/m²
Carbon dioxide emissions	3.0 tonnes	3.0 tonnes	0.0 tonnes
CO2 emissions per m²	11 kg/m²	11 kg/m²	0 kg/m²
Primary energy	71 kWh/m²	71 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable


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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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	239.2 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	2099.59 (P1)
Transmission heat loss coefficient	191.19 (37)
Summer heat loss coefficient	2290.78 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
East	1.000	1.00	1.000	1.000 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	1.3200	81.1852	0.4500	0.7000	0.9000	27.3430
South	0.9000	112.2060	0.4500	0.7000	0.9000	25.7664
West	33.1800	117.5071	0.4500	0.7000	0.9000	994.8004
North	1.2000	81.1852	0.6300	0.7000	0.9000	34.8002
East	2.8200	117.5071	0.6300	0.7000	0.9000	118.3687
South	2.2400	112.2060	0.6300	0.7000	0.9000	89.7817
East	1.0800	186.3884	0.6300	0.7000	1.0000	79.8958
West	2.1600	181.7331	0.6300	0.7000	1.0000	155.8005
total:						1526.5566

	Jun	Jul	Aug	
Solar gains	1620	1527	1346	(P3)
Internal gains	788	757	769	
Total summer gains	2409	2284	2115	(P5)
Summer gain/loss ratio	1.05	1.00	0.92	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 239.2)	0.33	0.33	0.33	
Threshold temperature	17.38	19.22	19.05	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant