elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Metis Build Ltd

Project: Plot 6, Long Copse Lane
Emsworth, Hampshire, PO10 7UR

Contact: Scott Spearing
Scott Spearing
scott@beatsolutions.co.uk

Report Issue Date: 10/05/2022

EXCELLENCE IN ENERGY ASSESSMENT

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	SAP-1231 - Plot 6	**Issued on Date**	10/05/2022
Assessment Reference	Rev A	**Prop Type Ref**	
Property	Plot 6, Long Copse Lane, Emsworth, Hampshire, PO10 7UR		

SAP Rating	88 B	**DER**	13.61	**TER**	17.01
Environmental	89 B	**% DER<TER**	19.97		
CO_2 Emissions (t/year)	1.00	**DFEE**	47.57	**TFEE**	52.20
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.87		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	Metis Build Ltd, METIS BUILD		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.01	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	13.61	$kgCO_2/m^2$	Pass
	-3.40 (-20.0%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	52.20	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	47.57	$kWh/m^2/yr$	
	-4.6 (-8.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.19 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.45 (max. 2.00)	1.60 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Vaillant ecoTEC sustain 28 VUW 286/7-2 (H-GB) Combi boiler Efficiency: 89.1% SEDBUK2009 Minimum: 88.0%	Pass
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	No cylinder	

6 Controls

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

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system (decentralised)		
Specific fan power	0.2000 0.1800	
Maximum	0.7	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Not significant	Pass

Based on:

Overshading	Average
Windows facing North	6.39 m², No overhang
Windows facing East	0.90 m², No overhang
Windows facing South	8.55 m², No overhang
Windows facing West	3.00 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K
Photovoltaic array	0.76	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

SUMMARY FOR INPUT DATA
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Environmental	89 B	**% DER<TER**	19.97		
CO_2 Emissions (t/year)	1.00	**DFEE**	47.57	**TFEE**	52.20
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.87		

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

Orientation	North
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2021
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	22.45 m	54.01 m²	2.48 m
1st Storey:	20.56 m	51.83 m²	2.65 m

7.0 Living Area	21.86	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	206.81	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.19	60.00	110.16	89.22

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall	Filled Cavity with Edge Sealing	Single plasterboard on dabs both sides, lightweight aggregate blocks, cavity or cavity fill	0.00	110.00	53.40

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall - Masonry	Dense block, plasterboard on dabs	75.00	46.67
Internal Wall - Timber	Plasterboard on timber frame	9.00	84.25

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	51.83	51.83
Bay Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	2.18	2.18

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	51.83

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	54.01

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	51.83

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front Door	Manufacturer	Solid Door							1.60
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
French Doors	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.50

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] External Walls	North							2.10	
Front Elevation	Window	[1] External Walls	North	None	0.00					6.39	
Side Elevation	Window	[1] External Walls	West	None	0.00					3.00	
Rear French Doors	Window	[1] External Walls	South	None	0.00					5.67	
Rear Elevation	Window	[1] External Walls	South	None	0.00					2.88	
Side Elevation	Window	[1] External Walls	East	None	0.00					0.90	

14.0 Conservatory None

15.0 Draught Proofing 100 %

16.0 Draught Lobby No

17.0 Thermal Bridging Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	13.93	0.050	Yes	Hi-Therms
Table K1 - Approved	E3 Sill	12.93	0.040	Yes	
Table K1 - Approved	E4 Jamb	28.20	0.050	No	
Table K1 - Approved	E5 Ground floor (normal)	22.45	0.160	Yes	
Table K1 - Approved	E6 Intermediate floor within a dwelling	20.56	0.070	Yes	
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	18.94	0.060	No	
Table K1 - Approved	E12 Gable (insulation at ceiling level)	5.80	0.240	No	
Table K1 - Approved	E16 Corner (normal)	20.33	0.090	No	
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	10.08	-0.090	No	
Table K1 - Approved	E18 Party wall between dwellings	10.26	0.060	Yes	
Table K1 - Default	P1 Party wall - Ground floor	10.41	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	10.41	0.000	No	
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	10.41	0.240	No	

Y-value	0.073	W/m²K

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

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	8.00

Mechanical Ventilation

Mechanical Ventilation System Present	Yes
Approved Installation	Yes
Mechanical Ventilation data Type	Database
Type	Mechanical extract ventilation - decentralised
MV Reference Number	500230
Duct Type	Flexible

19.1 Mechanical extract ventilation - Decentralised

SFP	Fan/Room Type	Count
0.20	In Room Fan Kitchen	1
0.18	In Room Fan Other Wet Room	3

20.0 Fans, Open Fireplaces, Flues

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

21.0 Fixed Cooling System	No

22.0 Lighting		
Internal		
Total number of light fittings	50	
Total number of L.E.L. fittings	50	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Gas Boiler	
Percentage of Heat	100	%
Database Ref. No.	18119	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.0	
In Summer	87.0	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
29.0 Hot Water Cylinder	None	
32.0 Photovoltaic Unit	One Dwelling	

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

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£28	B 89	

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

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Environmental	89 B	% DER<TER	19.97		
CO_2 Emissions (t/year)	1.00	DFEE	47.57	TFEE	52.20
General Requirements Compliance	Pass	% DFEE<TFEE	8.87		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	Assessor ID	p775-0001
Client	Metis Build Ltd, METIS BUILD		

Building Elements

Roof Pitched Cold Roof

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Mineral wool**				
	Main construction	200	0.0400	5.0000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Mineral wool**				
	Main construction	200	0.0400	5.0000	91.67
	Main construction	200	0.1300	1.5385	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 4	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 9.788 m² K/W **Lower limit =** 9.418 m² K/W **Average =** 9.603 m² K/W

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

Unheated space: None

Total thickness: 416 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

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Environmental	89 B	**% DER<TER**	19.97		
CO_2 Emissions (t/year)	1.00	**DFEE**	47.57	**TFEE**	52.20
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Building Elements

Roof Bay Roof

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Mineral wool**				
	Main construction	300	0.0400	7.5000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Mineral wool**				
	Main construction	100	0.0400	2.5000	92.50
	Main construction	100	0.1300	0.7692	7.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 4	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 10.053 m² K/W **Lower limit =** 9.846 m² K/W **Average =** 9.950 m² K/W

Total correction = 0.0005 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 416 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP-1231 - Plot 6	**Issued on Date**	10/05/2022
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Building Elements

Wall External Walls

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Brick, outer leaf**				
	Main construction	102.5	0.7700	0.1331	82.81
	Main construction	102.5	0.9407	0.1090	17.19
Layer 2	**Earthwool Dritherm 37 Standard**				
	Main construction	150	0.0370	4.0541	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 3	**Supabloc**				
	Main construction	100	0.1100	0.9091	94.04
	Main construction	100	0.8803	0.1136	5.96
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**airspace/plaster dabs**				
	Main construction	15	0.0882	0.1700	80.00
	Main construction	15	0.0882	0.1700	20.00
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 6	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 5.444 m² K/W **Lower limit =** 5.231 m² K/W **Average =** 5.337 m² K/W

Total correction = 0.0001 m² K/W **U-value (unrounded) =** 0.19 W/m² K

Unheated space: None

Total thickness: 383 mm **U-value: 0.19 W/m² K** **Kappa: n/a**

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Building Elements

Floor Ground Floor

Floor Type: Suspended Floor
Area = 54.01 m², Perimeter = 22.45 m, Wall thickness = 320.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.1700	
Layer 1	**Blockwork, dense**				
	Main construction	100	1.5900	0.0629	82.95
	Main construction	100	2.3000	0.0435	17.05
Layer 2	**Celotex XR4000**				
	Main construction	150	0.0220	6.8182	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Screed**				
	Main construction	75	1.1500	0.0652	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 7.283 m² K/W **Lower limit =** 7.282 m² K/W **Average =** 7.282 m² K/W

Total correction = 0.0088 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 325 mm **U-value: 0.12 W/m² K** **Kappa: n/a**

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

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

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 106 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.19 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.45 (max. 2.00)	1.60 (max. 3.30)	OK

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

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

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC sustain 28 VUW 286/7-2 (H-GB)
Combi boiler
Efficiency: 89.1% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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

Hot water controls: No cylinder

Boiler interlock Yes OK

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

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8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.2000 0.1800
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Southern England): Not significant OK
Based on:
Overshading: Average
Windows facing North: 6.39 m², No overhang
Windows facing East: 0.90 m², No overhang
Windows facing South: 8.55 m², No overhang
Windows facing West: 3.00 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Photovoltaic array 0.76 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		271.2943	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2313	0.2486	0.2602	0.2717	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5448	0.5391	0.5333	0.5044	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5102	0.5217	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	48.7783	48.2607	47.7431	45.1552	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	45.6728	46.7080	(38)
Heat transfer coeff	122.3415	121.8239	121.3063	118.7185	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	119.2360	120.2712	(39)
Average = Sum(39)m / 12 =												119.4715	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1559	1.1510	1.1461	1.1217	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1266	1.1363	(40)
HLP (average)												1.1288	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(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													
	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
								Total per year (kWh/year) = Sum(64)m =				1797.6540	(64)
Heat gains from water heating, kWh/month													
	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2130	21.5058	17.4897	13.2408	9.8977	8.3560	9.0290	11.7362	15.7523	20.0012	23.3444	24.8860	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.4381	268.1925	261.2515	246.4748	227.8219	210.2909	198.5790	195.8246	202.7656	217.5423	236.1952	253.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains													
	436.9888	434.6991	418.8893	393.2592	366.9637	341.8476	325.6863	332.2178	345.5237	371.3840	401.0904	423.6228	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.3900	10.6334	0.6300	0.7000	0.7700	20.7656	(74)
East	0.9000	19.6403	0.6300	0.7000	0.7700	5.4021	(76)
South	2.8800	46.7521	0.6300	0.7000	0.7700	41.1496	(78)
West	3.0000	19.6403	0.6300	0.7000	0.7700	18.0070	(80)
South	5.6700	46.7521	0.6300	0.7000	0.7700	81.0132	(78)

Solar gains	166.3374	285.5483	397.7027	506.3441	580.8611	583.0470	559.4357	502.6320	435.0129	317.3715	199.6099	142.1215	(83)
Total gains	603.3262	720.2474	816.5920	899.6033	947.8248	924.8946	885.1221	834.8498	780.5366	688.7556	600.7003	565.7444	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	49.6979	49.9091	50.1220	51.2146	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	50.9923	50.5534	
alpha	4.3132	4.3273	4.3415	4.4143	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.3995	4.3702	
util living area													
	0.9963	0.9917	0.9805	0.9486	0.8710	0.7263	0.5637	0.6141	0.8336	0.9647	0.9926	0.9972	(86)
MIT	19.5199	19.7186	20.0144	20.3971	20.7156	20.9115	20.9776	20.9673	20.8284	20.4142	19.9041	19.4989	(87)
Th 2	19.9554	19.9594	19.9633	19.9832	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9792	19.9713	(88)
util rest of house													
	0.9953	0.9893	0.9747	0.9323	0.8292	0.6416	0.4452	0.4955	0.7665	0.9504	0.9901	0.9964	(89)
MIT 2	18.6059	18.8065	19.1022	19.4899	19.7849	19.9407	19.9793	19.9751	19.8845	19.5143	19.0074	18.5973	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	18.7946	18.9949	19.2906	19.6773	19.9771	20.1412	20.1855	20.1800	20.0795	19.7002	19.1926	18.7835	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6446	18.8449	19.1406	19.5273	19.8271	19.9912	20.0355	20.0300	19.9295	19.5502	19.0426	18.6335	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9934	0.9858	0.9686	0.9232	0.8215	0.6420	0.4512	0.5009	0.7620	0.9423	0.9869	0.9950	(94)
Useful gains	599.3541	710.0187	790.9478	830.5326	778.6840	593.7991	399.3805	418.2080	594.7993	649.0347	592.8355	562.8968	(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													
	1754.9457	1698.8196	1533.3844	1261.6571	961.6569	637.9228	406.5075	429.5278	689.7823	1059.0490	1423.9913	1735.9343	(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													
	859.7601	664.4742	552.3728	310.4096	136.1319	0.0000	0.0000	0.0000	0.0000	305.0506	598.4322	872.7400	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating		4299.3714	(98)
Space heating per m2	(98) / (4) =	40.6214	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4777.0794	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	859.7601	664.4742	552.3728	310.4096	136.1319	0.0000	0.0000	0.0000	0.0000	305.0506	598.4322	872.7400	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	955.2890	738.3046	613.7476	344.8996	151.2576	0.0000	0.0000	0.0000	0.0000	338.9452	664.9247	969.7111	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
Efficiency of water heater												87.0000	(216)
(217)m	89.4595	89.4011	89.2869	89.0145	88.4428	87.0000	87.0000	87.0000	87.0000	88.9781	89.3368	89.4788	(217)
Fuel for water heating, kWh/month													
	204.1405	179.2095	186.4728	164.8975	160.5773	142.8851	134.4438	151.4147	152.4034	171.2185	183.7653	198.2628	(219)
Water heating fuel used												2029.6911	(219)

Annual totals kWh/year		
Space heating fuel - main system	4777.0794	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 10.0340, total flow = 37.0000, SFP = 0.2712)		
mechanical ventilation fans (SFP = 0.2712)	89.7579	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	164.7579	(231)
Electricity for lighting (calculated in Appendix L)	427.6098	(232)

Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.76 * 1068 * 1.00) =	-649.3869	-649.3869	(233)
Total delivered energy for all uses		6749.7514	(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	4777.0794	0.2160	1031.8491	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2029.6911	0.2160	438.4133	(264)
Space and water heating			1470.2624	(265)
Pumps and fans	164.7579	0.5190	85.5094	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Energy saving/generation technologies				
PV Unit	-649.3869	0.5190	-337.0318	(269)
Total CO2, kg/year			1440.6695	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.6100	(273)

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

DER		13.6100	ZC1
Total Floor Area	TFA	105.8400	
Assumed number of occupants	N	2.7874	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8614	ZC2
CO2 emissions from cooking, equation (L16)		1.7564	ZC3
Total CO2 emissions		30.2278	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		30.2278	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	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(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) =		0.1474	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3974	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3676	(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	0.4687	0.4595	0.4504	0.4044	0.3952	0.3493	0.3493	0.3401	0.3676	0.3952	0.4136	0.4320	(22b)
Effective ac	0.6099	0.6056	0.6014	0.5818	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.40)			18.8400	1.3258	24.9773			(27)
Ground Floor			54.0100	0.1300	7.0213			(28a)
External Walls	110.1600	20.9400	89.2200	0.1800	16.0596			(29a)
Pitched Cold Roof	51.8300		51.8300	0.1300	6.7379			(30)
Bay Roof	2.1800		2.1800	0.1300	0.2834			(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.1795			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.4495	(36)
Total fabric heat loss (33) + (36) =	68.6290	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.5986	54.2167	53.8423	52.0840	51.7551	50.2237	50.2237	49.9401	50.8135	51.7551	52.4206	53.1163	(38)
Heat transfer coeff	123.2275	122.8456	122.4713	120.7130	120.3840	118.8526	118.8526	118.5690	119.4425	120.3840	121.0495	121.7453	(39)
Average = Sum(39)m / 12 =												120.7114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1643	1.1607	1.1571	1.1405	1.1374	1.1229	1.1229	1.1203	1.1285	1.1374	1.1437	1.1503	(40)
HLP (average)												1.1405	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.5226	48.0935	44.5616	46.0469	48.0935	48.5226	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	214.7399	189.2713	198.7738	177.3912	171.7460	151.2643	144.9227	161.5548	163.3390	184.7664	195.3764	209.5721	(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													
	214.7399	189.2713	198.7738	177.3912	171.7460	151.2643	144.9227	161.5548	163.3390	184.7664	195.3764	209.5721	(64)
								Total per year (kWh/year) = Sum(64)m =				2162.7179	(64)
Heat gains from water heating, kWh/month													
	67.1969	59.1355	61.8882	54.9795	53.1378	46.6190	44.3879	49.7493	50.3071	57.2307	60.8942	65.4786	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2130	21.5058	17.4897	13.2408	9.8977	8.3560	9.0290	11.7362	15.7523	20.0012	23.3444	24.8860	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.4381	268.1925	261.2515	246.4748	227.8219	210.2909	198.5790	195.8246	202.7656	217.5423	236.1952	253.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	90.3184	87.9992	83.1830	76.3604	71.4218	64.7487	59.6612	66.8673	69.8710	76.9230	84.5752	88.0089	(72)
Total internal gains													
	447.7807	445.5087	429.7354	403.8872	376.9526	351.2067	335.0804	342.2393	356.2001	382.2777	411.9259	434.4323	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.3900	10.6334	0.6300	0.7000	0.7700	20.7656	(74)
East	0.9000	19.6403	0.6300	0.7000	0.7700	5.4021	(76)
South	8.5500	46.7521	0.6300	0.7000	0.7700	122.1627	(78)
West	3.0000	19.6403	0.6300	0.7000	0.7700	18.0070	(80)

Solar gains	166.3374	285.5483	397.7027	506.3441	580.8611	583.0470	559.4357	502.6320	435.0129	317.3715	199.6099	142.1215	(83)
Total gains	614.1181	731.0569	827.4381	910.2312	957.8137	934.2537	894.5161	844.8713	791.2131	699.6492	611.5358	576.5538	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.6458	59.8312	60.0141	60.8882	61.0546	61.8413	61.8413	61.9892	61.5359	61.0546	60.7189	60.3719	
alpha	4.9764	4.9887	5.0009	5.0592	5.0703	5.1228	5.1228	5.1326	5.1024	5.0703	5.0479	5.0248	
util living area													
	0.9983	0.9956	0.9882	0.9635	0.8930	0.7405	0.5685	0.6196	0.8527	0.9762	0.9961	0.9988	(86)
MIT	19.7213	19.8930	20.1509	20.4812	20.7650	20.9386	20.9871	20.9804	20.8668	20.4940	20.0464	19.6961	(87)
Th 2	19.9487	19.9516	19.9544	19.9679	19.9704	19.9821	19.9821	19.9843	19.9776	19.9704	19.9653	19.9600	(88)
util rest of house													
	0.9977	0.9941	0.9839	0.9493	0.8510	0.6503	0.4452	0.4956	0.7824	0.9643	0.9946	0.9983	(89)
MIT 2	18.2433	18.4958	18.8723	19.3535	19.7352	19.9402	19.9773	19.9761	19.8693	19.3798	18.7304	18.2145	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	18.5485	18.7844	19.1364	19.5864	19.9479	20.1464	20.1859	20.1835	20.0754	19.6100	19.0022	18.5205	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5485	18.7844	19.1364	19.5864	19.9479	20.1464	20.1859	20.1835	20.0754	19.6100	19.0022	18.5205	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9916	0.9792	0.9426	0.8499	0.6661	0.4708	0.5211	0.7902	0.9587	0.9923	0.9974	(94)
Useful gains	611.9713	724.9183	810.2234	858.0038	814.0665	622.3219	421.1343	440.2703	625.2285	670.7385	606.8556	575.0671	(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													
	1755.8107	1705.6385	1547.5964	1289.9863	992.9184	659.2019	426.1900	448.6076	713.7109	1084.6546	1440.7531	1743.4567	(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													
	851.0165	659.0440	548.6055	311.0275	133.0658	0.0000	0.0000	0.0000	0.0000	307.9536	600.4062	869.2819	(98)
Space heating												4280.4009	(98)
Space heating per m2											(98) / (4) =	40.4422	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4582.8703	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	851.0165	659.0440	548.6055	311.0275	133.0658	0.0000	0.0000	0.0000	0.0000	307.9536	600.4062	869.2819	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	911.1526	705.6146	587.3720	333.0058	142.4687	0.0000	0.0000	0.0000	0.0000	329.7148	642.8332	930.7086	(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	214.7399	189.2713	198.7738	177.3912	171.7460	151.2643	144.9227	161.5548	163.3390	184.7664	195.3764	209.5721	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1656	87.9324	87.4738	86.4508	84.4174	80.3000	80.3000	80.3000	80.3000	86.3282	87.6920	88.2439	(217)
Fuel for water heating, kWh/month	243.5643	215.2465	227.2381	205.1933	203.4486	188.3739	180.4766	201.1891	203.4110	214.0277	222.7984	237.4917	(219)
Water heating fuel used												2542.4592	(219)

Annual totals kWh/year		
Space heating fuel - main system	4582.8703	(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)	427.6098	(232)
Total delivered energy for all uses	7627.9394	(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	4582.8703	0.2160	989.9000	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2542.4592	0.2160	549.1712	(264)
Space and water heating			1539.0712	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Total CO2, kg/m2/year			1799.9257	(272)
Emissions per m2 for space and water heating			14.5415	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0968	(272b)
Emissions per m2 for pumps and fans			0.3678	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5415 * 1.00) + 2.0968 + 0.3678, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		271.2943	(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) =	0.1474	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3974	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3676	(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	0.4687	0.4595	0.4504	0.4044	0.3952	0.3493	0.3493	0.3401	0.3676	0.3952	0.4136	0.4320	(22b)
Effective ac	0.6099	0.6056	0.6014	0.5818	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			9.0000	466.4700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21421.9500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	202.3994	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.5986	54.2167	53.8423	52.0840	51.7551	50.2237	50.2237	49.9401	50.8135	51.7551	52.4206	53.1163	(38)
Heat transfer coeff	128.1618	127.7799	127.4055	125.6473	125.3183	123.7869	123.7869	123.5033	124.3768	125.3183	125.9838	126.6795	(39)
Average = Sum(39)m / 12 =												125.6457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2109	1.2073	1.2038	1.1871	1.1840	1.1696	1.1696	1.1669	1.1751	1.1840	1.1903	1.1969	(40)
HLP (average)												1.1871	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(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													
	34.8035	30.4393	31.4107	27.3846	26.2762	22.6743	21.0111	24.1105	24.3985	28.4341	31.0380	33.7053	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	139.3706	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2130	21.5058	17.4897	13.2408	9.8977	8.3560	9.0290	11.7362	15.7523	20.0012	23.3444	24.8860	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.4381	268.1925	261.2515	246.4748	227.8219	210.2909	198.5790	195.8246	202.7656	217.5423	236.1952	253.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	36.9371	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	46.7789	45.2966	42.2186	38.0341	35.3174	31.4921	28.2407	32.4066	33.8868	38.2179	43.1084	45.3028	(72)
Total internal gains													
	401.2411	399.8061	385.7710	362.5609	337.8482	314.9502	300.6599	304.7786	317.2160	340.5725	367.4591	388.7262	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.3900	10.6334	0.6300	0.7000	0.7700	20.7656	(74)
East	0.9000	19.6403	0.6300	0.7000	0.7700	5.4021	(76)
South	2.8800	46.7521	0.6300	0.7000	0.7700	41.1496	(78)
West	3.0000	19.6403	0.6300	0.7000	0.7700	18.0070	(80)
South	5.6700	46.7521	0.6300	0.7000	0.7700	81.0132	(78)

Solar gains	166.3374	285.5483	397.7027	506.3441	580.8611	583.0470	559.4357	502.6320	435.0129	317.3715	199.6099	142.1215	(83)
Total gains	567.5785	685.3544	783.4737	868.9050	918.7093	897.9972	860.0956	807.4106	752.2289	657.9441	567.0690	530.8478	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	46.4299	46.5687	46.7055	47.3591	47.4834	48.0709	48.0709	48.1812	47.8429	47.4834	47.2326	46.9732	
alpha	4.0953	4.1046	4.1137	4.1573	4.1656	4.2047	4.2047	4.2121	4.1895	4.1656	4.1488	4.1315	
util living area													
	0.9968	0.9927	0.9829	0.9557	0.8889	0.7542	0.5958	0.6471	0.8565	0.9704	0.9937	0.9976	(86)
MIT	19.3765	19.5791	19.8875	20.2850	20.6383	20.8804	20.9665	20.9525	20.7777	20.3106	19.7700	19.3467	(87)
Th 2	19.9113	19.9142	19.9170	19.9303	19.9328	19.9444	19.9444	19.9466	19.9399	19.9328	19.9277	19.9225	(88)
util rest of house													
	0.9959	0.9906	0.9777	0.9411	0.8501	0.6693	0.4695	0.5228	0.7929	0.9580	0.9915	0.9969	(89)
MIT 2	18.4311	18.6350	18.9428	19.3415	19.6728	19.8814	19.9339	19.9300	19.8050	19.3736	18.8364	18.4100	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	18.6264	18.8300	19.1379	19.5364	19.8722	20.0878	20.1471	20.1412	20.0059	19.5671	19.0292	18.6035	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6264	18.8300	19.1379	19.5364	19.8722	20.0878	20.1471	20.1412	20.0059	19.5671	19.0292	18.6035	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9877	0.9728	0.9345	0.8475	0.6821	0.4953	0.5476	0.7976	0.9524	0.9890	0.9957	(94)
Useful gains	564.3690	676.9062	762.1620	811.9617	778.6433	612.5201	425.9710	442.1370	599.9689	626.6427	560.8371	528.5512	(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													
	1836.0921	1779.9745	1610.1396	1336.4309	1024.1291	679.3137	439.0890	462.0526	734.5560	1123.7435	1502.8895	1824.6234	(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													
	946.1620	741.2619	630.8953	377.6178	182.6415	0.0000	0.0000	0.0000	0.0000	369.8430	678.2777	964.2777	(98)
Space heating												4890.9769	(98)
Space heating per m2											(98) / (4) =	46.2110	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1163.5967	916.0229	938.6250	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8059	0.8771	0.8511	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	937.7563	803.4213	798.9037	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1157.9928	1111.3458	1051.7748	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	158.5703	229.0959	188.1361	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												575.8022	(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	39.6426	57.2740	47.0340	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												143.9506	(107)
Space cooling per m2												1.3601	(108)
Energy for space heating												46.2110	(99)
Energy for space cooling												1.3601	(108)
Total												47.5711	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.6	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(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) =	0.1474	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3974	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3676	(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	0.4687	0.4595	0.4504	0.4044	0.3952	0.3493	0.3493	0.3401	0.3676	0.3952	0.4136	0.4320	(22b)
Effective ac	0.6099	0.6056	0.6014	0.5818	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.40)			18.8400	1.3258	24.9773			(27)
Ground Floor			54.0100	0.1300	7.0213			(28a)
External Walls	110.1600	20.9400	89.2200	0.1800	16.0596			(29a)
Pitched Cold Roof	51.8300		51.8300	0.1300	6.7379			(30)
Bay Roof	2.1800		2.1800	0.1300	0.2834			(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.1795			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.4495	(36)
Total fabric heat loss	(33) + (36) =	68.6290	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.5986	54.2167	53.8423	52.0840	51.7551	50.2237	50.2237	49.9401	50.8135	51.7551	52.4206	53.1163	(38)
Heat transfer coeff	123.2275	122.8456	122.4713	120.7130	120.3840	118.8526	118.8526	118.5690	119.4425	120.3840	121.0495	121.7453	(39)
Average = Sum(39)m / 12 =												120.7114	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1643	1.1607	1.1571	1.1405	1.1374	1.1229	1.1229	1.1203	1.1285	1.1374	1.1437	1.1503	(40)
HLP (average)												1.1405	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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
               34.8035   30.4393   31.4107   27.3846   26.2762   22.6743   21.0111   24.1105   24.3985   28.4341   31.0380   33.7053 (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          139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706  139.3706 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.2130   21.5058   17.4897   13.2408    9.8977    8.3560    9.0290   11.7362   15.7523   20.0012   23.3444   24.8860 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              265.4381  268.1925  261.2515  246.4748  227.8219  210.2909  198.5790  195.8246  202.7656  217.5423  236.1952  253.7262 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371   36.9371 (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)
             -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 -111.4965 (71)
Water heating gains (Table 5)
               46.7789   45.2966   42.2186   38.0341   35.3174   31.4921   28.2407   32.4066   33.8868   38.2179   43.1084   45.3028 (72)
Total internal gains
              401.2411  399.8061  385.7710  362.5609  337.8482  314.9502  300.6599  304.7786  317.2160  340.5725  367.4591  388.7262 (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                                    6.3900          10.6334          0.6300           0.7000          0.7700          20.7656 (74)
East                                     0.9000          19.6403          0.6300           0.7000          0.7700           5.4021 (76)
South                                    8.5500          46.7521          0.6300           0.7000          0.7700         122.1627 (78)
West                                     3.0000          19.6403          0.6300           0.7000          0.7700          18.0070 (80)
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Solar gains    166.3374  285.5483  397.7027  506.3441  580.8611  583.0470  559.4357  502.6320  435.0129  317.3715  199.6099  142.1215 (83)
Total gains    567.5785  685.3544  783.4737  868.9050  918.7093  897.9972  860.0956  807.4106  752.2289  657.9441  567.0690  530.8478 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                          21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau            59.6458   59.8312   60.0141   60.8882   61.0546   61.8413   61.8413   61.9892   61.5359   61.0546   60.7189   60.3719
alpha           4.9764    4.9887    5.0009    5.0592    5.0703    5.1228    5.1228    5.1326    5.1024    5.0703    5.0479    5.0248
util living area
                0.9988    0.9967    0.9906    0.9694    0.9058    0.7603    0.5885    0.6433    0.8718    0.9815    0.9973    0.9992 (86)

MIT            19.6804   19.8534   20.1141   20.4504   20.7444   20.9305   20.9850   20.9768   20.8500   20.4608   20.0076   19.6558 (87)
Th 2           19.9487   19.9516   19.9544   19.9679   19.9704   19.9821   19.9821   19.9843   19.9776   19.9704   19.9653   19.9600 (88)
util rest of house
                0.9984    0.9955    0.9871    0.9572    0.8669    0.6711    0.4623    0.5169    0.8060    0.9718    0.9961    0.9989 (89)
MIT 2          18.7435   18.9183   19.1796   19.5196   19.7933   19.9491   19.9782   19.9775   19.8923   19.5358   19.0836   18.7280 (90)
Living area fraction                                                                          fLA = Living area / (4) =       0.2065 (91)
MIT            18.9370   19.1114   19.3726   19.7118   19.9897   20.1518   20.1862   20.1839   20.0901   19.7269   19.2745   18.9196 (92)
Temperature adjustment                                                                                                     0.0000
adjusted MIT   18.9370   19.1114   19.3726   19.7118   19.9897   20.1518   20.1862   20.1839   20.0901   19.7269   19.2745   18.9196 (93)


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8. Space heating requirement
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                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation     0.9978    0.9943    0.9845    0.9534    0.8678    0.6874    0.4886    0.5432    0.8145    0.9688    0.9950    0.9984 (94)
Useful gains  566.3439  681.4173  771.3523  828.3782  797.2448  617.3074  420.2484  438.6123  612.6849  637.4269  564.2490  530.0204 (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
             1803.6866 1745.8132 1576.5198 1305.1295  997.9481  659.8494  426.2246  448.6551  715.4731 1098.7293 1473.7143 1792.0468 (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
              920.5830  715.2741  599.0446  343.2609  149.3232    0.0000    0.0000    0.0000    0.0000  343.2090  654.8150  938.9476 (98)
Space heating                                                                                                          4664.4574 (98)
Space heating per m2                                                                                   (98) / (4) =     44.0708 (99)


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8c. Space cooling requirement
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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 1117.2148  879.5096  901.1248    0.0000    0.0000    0.0000    0.0000 (100)
Utilisation     0.0000    0.0000    0.0000    0.0000    0.0000    0.8513    0.9173    0.8942    0.0000    0.0000    0.0000    0.0000 (101)
Useful loss     0.0000    0.0000    0.0000    0.0000    0.0000  951.0790  806.8140  805.8163    0.0000    0.0000    0.0000    0.0000 (102)
Total gains     0.0000    0.0000    0.0000    0.0000    0.0000 1157.9928 1111.3458 1051.7748    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
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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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                0.0000     0.0000     0.0000     0.0000     0.0000   148.9779   226.5717   182.9931     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          558.5427 (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    37.2445    56.6429    45.7483     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          139.6357 (107)
Space cooling per m2                                                                                                                     1.3193 (108)
Energy for space heating                                                                                                                44.0708 (99)
Energy for space cooling                                                                                                                 1.3193 (108)
Total                                                                                                                                   45.3901 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                     52.2 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.2000	4.1000	4.0000	4.2000	3.7000	3.9000	3.7000	3.7000	4.0000	3.9000	4.1000	(22)
Wind factor	1.1500	1.0500	1.0250	1.0000	1.0500	0.9250	0.9750	0.9250	0.9250	1.0000	0.9750	1.0250	(22a)
Adj infilt rate	0.2659	0.2428	0.2370	0.2313	0.2428	0.2139	0.2255	0.2139	0.2139	0.2313	0.2255	0.2370	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5159	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	46.1904	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	(38)
Heat transfer coeff	119.7536	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	(39)
Average = Sum(39)m / 12 =												118.4457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1315	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	(40)
HLP (average)												1.1191	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(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	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
								Total per year (kWh/year) = Sum(64)m =				1797.6540	(64)
RHI water heating demand												1798	(64)
Heat gains from water heating, kWh/month	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	60.5326	53.7645	43.7242	33.1021	24.7442	20.8901	22.5725	29.3405	39.3808	50.0030	58.3609	62.2150	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	396.1762	400.2873	389.9275	367.8728	340.0327	313.8669	296.3866	292.2755	302.6353	324.6900	352.5301	378.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	(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)	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains	649.4955	644.5016	619.2488	579.9674	539.4700	503.4067	482.4864	491.7220	514.4708	553.9825	597.8908	631.3704	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.3900	14.6401	0.6300	0.7000	0.7700	28.5901	(74)
East	0.9000	27.3735	0.6300	0.7000	0.7700	7.5291	(76)
South	2.8800	61.3950	0.6300	0.7000	0.7700	54.0377	(78)
West	3.0000	27.3735	0.6300	0.7000	0.7700	25.0971	(80)
South	5.6700	61.3950	0.6300	0.7000	0.7700	106.3868	(78)

Solar gains	221.6408	312.8001	435.9162	572.2033	637.7440	686.6868	657.8700	589.2837	508.6164	371.2684	254.9877	183.7266	(83)
Total gains	871.1363	957.3016	1055.1650	1152.1708	1177.2140	1190.0935	1140.3563	1081.0057	1023.0872	925.2509	852.8785	815.0970	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	50.7719	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	
alpha	4.3848	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	
util living area	0.9813	0.9710	0.9408	0.8648	0.7176	0.5032	0.3405	0.3481	0.6196	0.8681	0.9620	0.9845	(86)
MIT	19.9422	20.0886	20.3621	20.6720	20.8946	20.9829	20.9977	20.9975	20.9580	20.7292	20.3063	19.9326	(87)
Th 2	19.9752	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	(88)
util rest of house	0.9762	0.9633	0.9250	0.8298	0.6509	0.4112	0.2369	0.2390	0.5249	0.8242	0.9499	0.9801	(89)
MIT 2	19.0394	19.1913	19.4551	19.7405	19.9237	19.9799	19.9858	19.9858	19.9681	19.7975	19.4059	19.0392	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	19.2259	19.3766	19.6424	19.9329	20.1242	20.1871	20.1948	20.1948	20.1725	19.9899	19.5919	19.2237	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0759	19.2266	19.4924	19.7829	19.9742	20.0371	20.0448	20.0448	20.0225	19.8399	19.4419	19.0737	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9560	0.9156	0.8217	0.6501	0.4159	0.2429	0.2453	0.5285	0.8168	0.9417	0.9749	(94)
Useful gains	845.3045	915.1483	966.1407	946.7320	765.2914	494.9776	277.0494	265.2149	540.6720	755.7001	803.1156	794.6299	(95)
Ext temp.	5.3000	5.7000	7.4000	9.9000	13.0000	15.8000	17.7000	17.8000	15.3000	12.0000	8.4000	5.5000	(96)
Heat loss rate W	1649.7123	1600.5574	1430.8601	1169.4102	825.2400	501.3620	277.4527	265.6170	558.8001	927.6686	1306.5536	1606.1338	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	598.4794	460.5950	345.7513	160.3283	44.6018	0.0000	0.0000	0.0000	0.0000	127.9445	362.4754	603.7589 (98)
Space heating												2703.9345 (98)
RHI space heating demand												2704 (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	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2313	0.2486	0.2602	0.2717	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5448	0.5391	0.5333	0.5044	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5102	0.5217	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	48.7783	48.2607	47.7431	45.1552	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	45.6728	46.7080	(38)
Heat transfer coeff	122.3415	121.8239	121.3063	118.7185	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	119.2360	120.2712	(39)
Average = Sum(39)m / 12 =												119.4715	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1559	1.1510	1.1461	1.1217	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1266	1.1363	(40)
HLP (average)												1.1288	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
								Total per year (kWh/year) = Sum(64)m =				1797.6540	(64)
Heat gains from water heating, kWh/month													
	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(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	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5326	53.7645	43.7242	33.1021	24.7442	20.8901	22.5725	29.3405	39.3808	50.0030	58.3609	62.2150	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	396.1762	400.2873	389.9275	367.8728	340.0327	313.8669	296.3866	292.2755	302.6353	324.6900	352.5301	378.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains													
	649.4955	644.5016	619.2488	579.9674	539.4700	503.4067	482.4864	491.7220	514.4708	553.9825	597.8908	631.3704	(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	6.3900	10.6334	0.6300	0.7000	0.7700	20.7656	(74)
East	0.9000	19.6403	0.6300	0.7000	0.7700	5.4021	(76)
South	2.8800	46.7521	0.6300	0.7000	0.7700	41.1496	(78)
West	3.0000	19.6403	0.6300	0.7000	0.7700	18.0070	(80)
South	5.6700	46.7521	0.6300	0.7000	0.7700	81.0132	(78)

Solar gains	166.3374	285.5483	397.7027	506.3441	580.8611	583.0470	559.4357	502.6320	435.0129	317.3715	199.6099	142.1215	(83)
Total gains	815.8328	930.0499	1016.9516	1086.3115	1120.3311	1086.4537	1041.9221	994.3540	949.4837	871.3540	797.5007	773.4919	(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	49.6979	49.9091	50.1220	51.2146	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	50.9923	50.5534	
alpha	4.3132	4.3273	4.3415	4.4143	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.3995	4.3702	
util living area													
	0.9885	0.9788	0.9587	0.9089	0.8083	0.6473	0.4878	0.5295	0.7494	0.9251	0.9788	0.9907	(86)
MIT	19.7306	19.9201	20.1936	20.5357	20.7984	20.9440	20.9872	20.9816	20.8915	20.5608	20.0945	19.7072	(87)
Th 2	19.9554	19.9594	19.9633	19.9832	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9792	19.9713	(88)
util rest of house													
	0.9854	0.9732	0.9476	0.8841	0.7576	0.5624	0.3811	0.4210	0.6726	0.8994	0.9723	0.9882	(89)
MIT 2	18.8147	19.0044	19.2747	19.6157	19.8499	19.9589	19.9824	19.9803	19.9263	19.6479	19.1940	18.8040	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	19.0038	19.1935	19.4645	19.8057	20.0458	20.1624	20.1900	20.1871	20.1256	19.8365	19.3800	18.9906	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8538	19.0435	19.3145	19.6557	19.8958	20.0124	20.0400	20.0371	19.9756	19.6865	19.2300	18.8406	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9668	0.9389	0.8746	0.7525	0.5647	0.3869	0.4267	0.6717	0.8901	0.9659	0.9844	(94)
Useful gains	800.3300	899.1982	954.7811	950.1175	843.0487	613.5553	403.1436	424.3059	637.7833	775.5749	770.3375	761.4373	(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													
	1780.5386	1723.0165	1554.4766	1276.9057	969.7784	640.4326	407.0396	430.3679	695.2462	1075.1712	1446.3289	1760.8386	(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													
	729.2752	553.6058	446.1735	235.2875	94.2869	0.0000	0.0000	0.0000	0.0000	222.8996	486.7138	743.5545	(98)

Space heating		3511.7968 (98)
Space heating per m2	(98) / (4) =	33.1802 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3901.9964 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	729.2752	553.6058	446.1735	235.2875	94.2869	0.0000	0.0000	0.0000	0.0000	222.8996	486.7138	743.5545	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	810.3057	615.1176	495.7483	261.4306	104.7632	0.0000	0.0000	0.0000	0.0000	247.6662	540.7931	826.1717	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
Efficiency of water heater												87.0000	(216)
(217)m	89.3827	89.3088	89.1645	88.8233	88.1727	87.0000	87.0000	87.0000	87.0000	88.7574	89.2240	89.4061	(217)
Fuel for water heating, kWh/month													
	204.3159	179.3948	186.7289	165.2525	161.0692	142.8851	134.4438	151.4147	152.4034	171.6441	183.9977	198.4239	(219)
Water heating fuel used												2031.9740	(219)

Annual totals kWh/year	
Space heating fuel - main system	3901.9964 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 10.0340, total flow = 37.0000, SFP = 0.2712)	
mechanical ventilation fans (SFP = 0.2712)	89.7579 (230a)
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	164.7579 (231)
Electricity for lighting (calculated in Appendix L)	427.6098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 0.76 * 1068 * 1.00) =	-649.3869 -649.3869 (233)
Total delivered energy for all uses	5876.9513 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3901.9964	3.4800	135.7895	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2031.9740	3.4800	70.7127	(247)
Mechanical ventilation fans	89.7579	13.1900	11.8391	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	427.6098	13.1900	56.4017	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-649.3869	13.1900	-85.6541	(252)
Total energy cost			318.9813	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.8882 (257)
SAP value		87.6100
SAP rating (Section 12)		88 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3901.9964	0.2160	842.8312	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2031.9740	0.2160	438.9064	(264)
Space and water heating			1281.7376	(265)
Pumps and fans	164.7579	0.5190	85.5094	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Energy saving/generation technologies				
PV Unit	-649.3869	0.5190	-337.0318	(269)
Total kg/year			1252.1447	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	11.8300 (273)
EI value	88.8765
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9000 = 3.867, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9000 = 0.2400, stars = 4
Water heating energy efficiency	3.48 / 0.8835 = 3.939, stars = 4
Water heating environmental impact	0.216 / 0.8835 = 0.2445, 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	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.2000	4.1000	4.0000	4.2000	3.7000	3.9000	3.7000	3.7000	4.0000	3.9000	4.1000	(22)
Wind factor	1.1500	1.0500	1.0250	1.0000	1.0500	0.9250	0.9750	0.9250	0.9250	1.0000	0.9750	1.0250	(22a)
Adj infilt rate	0.2659	0.2428	0.2370	0.2313	0.2428	0.2139	0.2255	0.2139	0.2139	0.2313	0.2255	0.2370	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5159	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	46.1904	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	(38)
Heat transfer coeff	119.7536	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	(39)
Average = Sum(39)m / 12 =												118.4457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1315	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	(40)
HLP (average)												1.1191	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(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													
	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
								Total per year (kWh/year) = Sum(64)m =				1797.6540	(64)
Heat gains from water heating, kWh/month													
	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5326	53.7645	43.7242	33.1021	24.7442	20.8901	22.5725	29.3405	39.3808	50.0030	58.3609	62.2150	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	396.1762	400.2873	389.9275	367.8728	340.0327	313.8669	296.3866	292.2755	302.6353	324.6900	352.5301	378.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains													
	649.4955	644.5016	619.2488	579.9674	539.4700	503.4067	482.4864	491.7220	514.4708	553.9825	597.8908	631.3704	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.3900	14.6401	0.6300	0.7000	0.7700	28.5901	(74)
East	0.9000	27.3735	0.6300	0.7000	0.7700	7.5291	(76)
South	2.8800	61.3950	0.6300	0.7000	0.7700	54.0377	(78)
West	3.0000	27.3735	0.6300	0.7000	0.7700	25.0971	(80)
South	5.6700	61.3950	0.6300	0.7000	0.7700	106.3868	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	221.6408	312.8001	435.9162	572.2033	637.7440	686.6868	657.8700	589.2837	508.6164	371.2684	254.9877	183.7266	(83)
Total gains	871.1363	957.3016	1055.1650	1152.1708	1177.2140	1190.0935	1140.3563	1081.0057	1023.0872	925.2509	852.8785	815.0970	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.7719	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	
alpha	4.3848	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	
util living area													
	0.9813	0.9710	0.9408	0.8648	0.7176	0.5032	0.3405	0.3481	0.6196	0.8681	0.9620	0.9845	(86)
MIT	19.9422	20.0886	20.3621	20.6720	20.8946	20.9829	20.9977	20.9975	20.9580	20.7292	20.3063	19.9326	(87)
Th 2	19.9752	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	(88)
util rest of house													
	0.9762	0.9633	0.9250	0.8298	0.6509	0.4112	0.2369	0.2390	0.5249	0.8242	0.9499	0.9801	(89)
MIT 2	19.0394	19.1913	19.4551	19.7405	19.9237	19.9799	19.9858	19.9858	19.9681	19.7975	19.4059	19.0392	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)
MIT	19.2259	19.3766	19.6424	19.9329	20.1242	20.1871	20.1948	20.1948	20.1725	19.9899	19.5919	19.2237	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0759	19.2266	19.4924	19.7829	19.9742	20.0371	20.0448	20.0448	20.0225	19.8399	19.4419	19.0737	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9560	0.9156	0.8217	0.6501	0.4159	0.2429	0.2453	0.5285	0.8168	0.9417	0.9749	(94)
Useful gains	845.3045	915.1483	966.1407	946.7320	765.2914	494.9776	277.0494	265.2149	540.6720	755.7001	803.1156	794.6299	(95)
Ext temp.	5.3000	5.7000	7.4000	9.9000	13.0000	15.8000	17.7000	17.8000	15.3000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	1649.7123	1600.5574	1430.8601	1169.4102	825.2400	501.3620	277.4527	265.6170	558.8001	927.6686	1306.5536	1606.1338	(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													
	598.4794	460.5950	345.7513	160.3283	44.6018	0.0000	0.0000	0.0000	0.0000	127.9445	362.4754	603.7589	(98)

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Space heating		2703.9345 (98)
Space heating per m2	(98) / (4) =	25.5474 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		90.0000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		3004.3717 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	598.4794	460.5950	345.7513	160.3283	44.6018	0.0000	0.0000	0.0000	0.0000	127.9445	362.4754	603.7589	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	664.9771	511.7722	384.1681	178.1425	49.5575	0.0000	0.0000	0.0000	0.0000	142.1606	402.7504	670.8432	(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													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(64)
Efficiency of water heater												87.0000	(216)
(217)m	89.2802	89.2061	89.0025	88.5408	87.6987	87.0000	87.0000	87.0000	87.0000	88.3442	89.0429	89.3007	(217)
Fuel for water heating, kWh/month													
	204.5505	179.6012	187.0687	165.7799	161.9399	142.8851	134.4438	151.4147	152.4034	172.4469	184.3720	198.6582	(219)
Water heating fuel used												2035.5643	(219)
Annual totals kWh/year													
Space heating fuel - main system												3004.3717	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 10.0340, total flow = 37.0000, SFP = 0.2712)

mechanical ventilation fans (SFP = 0.2712)	89.7579	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	164.7579	(231)
Electricity for lighting (calculated in Appendix L)	427.6098	(232)

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

PV Unit 0 (0.80 * 0.76 * 1246 * 1.00) =	-757.5778	-757.5778 (233)
Total delivered energy for all uses		4874.7260 (238)

10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3004.3717	3.6300	109.0587	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2035.5643	3.6300	73.8910	(247)
Mechanical ventilation fans	89.7579	19.4400	17.4489	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	427.6098	19.4400	83.1273	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-757.5778	19.4400	-147.2731	(252)
Total energy cost			245.8328	(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	3004.3717	0.2160	648.9443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2035.5643	0.2160	439.6819	(264)
Space and water heating			1088.6262	(265)
Pumps and fans	164.7579	0.5190	85.5094	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Energy saving/generation technologies				
PV Unit	-757.5778	0.5190	-393.1829	(269)
Total kg/year			1002.8822	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3004.3717	1.2200	3665.3335	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2035.5643	1.2200	2483.3884	(264)

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

Space and water heating			6148.7219 (265)
Pumps and fans	164.7579	3.0700	505.8069 (267)
Energy for lighting	427.6098	3.0700	1312.7621 (268)
Energy saving/generation technologies			
PV Unit	-757.5778	3.0700	-2325.7638 (269)
Primary energy kWh/year			5641.5271 (272)
Primary energy kWh/m2/year			53.3024 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 28	-200 kg (20.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£28	1.89 kg/m²	B 89	B 91
Total Savings	£28	1.89 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 495 TEST (29 Apr 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£115	£125	-£10
Mains gas	£278	£240	£38
Space heating	£236	£236	£0
Water heating	£74	£46	£28
Lighting	£83	£83	£0
Generated (PV)	-£147	-£147	£0
Total cost of fuels	£246	£218	£28
Total cost of uses	£246	£218	£28
Delivered energy	46 kWh/m²	37 kWh/m²	9 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	9 kg/m²	8 kg/m²	2 kg/m²
Primary energy	53 kWh/m²	43 kWh/m²	11 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2313	(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	0.2948	0.2891	0.2833	0.2544	0.2486	0.2197	0.2197	0.2139	0.2313	0.2486	0.2602	0.2717	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5448	0.5391	0.5333	0.5044	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5102	0.5217	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	48.7783	48.2607	47.7431	45.1552	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	45.6728	46.7080	(38)
Heat transfer coeff	122.3415	121.8239	121.3063	118.7185	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	119.2360	120.2712	(39)
Average = Sum(39)m / 12 =												119.4715	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1559	1.1510	1.1461	1.1217	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1266	1.1363	(40)
HLP (average)												1.1288	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1079.5246	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1813.6014	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.1481	(H8)
Utilisation factor	0.5815	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	100.4010	(H14)
Volume ratio Veff/V	0.7470	(H15)
Solar storage volume factor	0.9417	(H16)
Solar input	-873.1834	(H17)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar input	-25.3206	-42.2528	-71.9613	-96.4423	-119.1464	-117.1399	-115.5918	-100.9931	-79.0979	-54.0145	-30.0339	-21.1890	(63)
								Solar input (sum of months) = Sum(63)m =				-873.1834	(63)
Output from w/h													
	157.3026	117.9625	94.5345	50.3404	22.8727	7.1702	1.3743	30.7377	53.4931	98.3324	134.1362	156.2141	(64)
								Total per year (kWh/year) = Sum(64)m =				924.4706	(64)
Heat gains from water heating, kWh/month													
	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(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	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5326	53.7645	43.7242	33.1021	24.7442	20.8901	22.5725	29.3405	39.3808	50.0030	58.3609	62.2150	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	396.1762	400.2873	389.9275	367.8728	340.0327	313.8669	296.3866	292.2755	302.6353	324.6900	352.5301	378.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains													
	649.4955	644.5016	619.2488	579.9674	539.4700	503.4067	482.4864	491.7220	514.4708	553.9825	597.8908	631.3704	(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	6.3900	10.6334	0.6300	0.7000	0.7700	20.7656	(74)
East	0.9000	19.6403	0.6300	0.7000	0.7700	5.4021	(76)
South	2.8800	46.7521	0.6300	0.7000	0.7700	41.1496	(78)
West	3.0000	19.6403	0.6300	0.7000	0.7700	18.0070	(80)
South	5.6700	46.7521	0.6300	0.7000	0.7700	81.0132	(78)

Solar gains	166.3374	285.5483	397.7027	506.3441	580.8611	583.0470	559.4357	502.6320	435.0129	317.3715	199.6099	142.1215	(83)
Total gains	815.8328	930.0499	1016.9516	1086.3115	1120.3311	1086.4537	1041.9221	994.3540	949.4837	871.3540	797.5007	773.4919	(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	49.6979	49.9091	50.1220	51.2146	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	50.9923	50.5534	
alpha	4.3132	4.3273	4.3415	4.4143	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.3995	4.3702	
util living area													
	0.9885	0.9788	0.9587	0.9089	0.8083	0.6473	0.4878	0.5295	0.7494	0.9251	0.9788	0.9907	(86)
MIT	19.7306	19.9201	20.1936	20.5357	20.7984	20.9440	20.9872	20.9816	20.8915	20.5608	20.0945	19.7072	(87)
Th 2	19.9554	19.9594	19.9633	19.9832	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9792	19.9713	(88)
util rest of house													
	0.9854	0.9732	0.9476	0.8841	0.7576	0.5624	0.3811	0.4210	0.6726	0.8994	0.9723	0.9882	(89)
MIT 2	18.8147	19.0044	19.2747	19.6157	19.8499	19.9589	19.9824	19.9803	19.9263	19.6479	19.1940	18.8040	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	19.0038	19.1935	19.4645	19.8057	20.0458	20.1624	20.1900	20.1871	20.1256	19.8365	19.3800	18.9906	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8538	19.0435	19.3145	19.6557	19.8958	20.0124	20.0400	20.0371	19.9756	19.6865	19.2300	18.8406	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9668	0.9389	0.8746	0.7525	0.5647	0.3869	0.4267	0.6717	0.8901	0.9659	0.9844	(94)
Useful gains	800.3300	899.1982	954.7811	950.1175	843.0487	613.5553	403.1436	424.3059	637.7833	775.5749	770.3375	761.4373	(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	1780.5386	1723.0165	1554.4766	1276.9057	969.7784	640.4326	407.0396	430.3679	695.2462	1075.1712	1446.3289	1760.8386	(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	729.2752	553.6058	446.1735	235.2875	94.2869	0.0000	0.0000	0.0000	0.0000	222.8996	486.7138	743.5545	(98)
Space heating												3511.7968	(98)
Space heating per m2											(98) / (4) =	33.1802	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3901.9964	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	729.2752	553.6058	446.1735	235.2875	94.2869	0.0000	0.0000	0.0000	0.0000	222.8996	486.7138	743.5545	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	810.3057	615.1176	495.7483	261.4306	104.7632	0.0000	0.0000	0.0000	0.0000	247.6662	540.7931	826.1717	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	157.3026	117.9625	94.5345	50.3404	22.8727	7.1702	1.3743	30.7377	53.4931	98.3324	134.1362	156.2141	(64)
Efficiency of water heater												87.0000	(216)
(217)m	89.4527	89.4582	89.4607	89.4563	89.3982	87.0000	87.0000	87.0000	87.0000	89.0599	89.3345	89.4644	(217)
Fuel for water heating, kWh/month	175.8500	131.8633	105.6716	56.2738	25.5853	8.2416	1.5796	35.3307	61.4863	110.4115	150.1506	174.6104	(219)
Water heating fuel used												1037.0545	(219)

Annual totals kWh/year		
Space heating fuel - main system	3901.9964	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 10.0340, total flow = 37.0000, SFP = 0.2712)		
mechanical ventilation fans (SFP = 0.2712)	89.7579	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	214.7579	(231)
Electricity for lighting (calculated in Appendix L)	427.6098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.76 * 1068 * 1.00) =	-649.3869	(233)
Total delivered energy for all uses	4932.0318	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3901.9964	3.4800	135.7895	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1037.0545	3.4800	36.0895	(247)
Mechanical ventilation fans	89.7579	13.1900	11.8391	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	427.6098	13.1900	56.4017	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-649.3869	13.1900	-85.6541	(252)
Total energy cost			290.9532	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.8101	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	88.6987	
SAP rating (Section 12)	89	(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	3901.9964	0.2160	842.8312	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1037.0545	0.2160	224.0038	(264)
Space and water heating			1066.8350	(265)
Pumps and fans	214.7579	0.5190	111.4594	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Energy saving/generation technologies				
PV Unit	-649.3869	0.5190	-337.0318	(269)
Total kg/year			1063.1921	(272)
CO2 emissions per m2			10.0500	(273)
EI value			90.5550	
EI rating			91	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	54.0100 (1b)	x	2.4800 (2b)	=	133.9448	(1b) - (3b)
First floor	51.8300 (1c)	x	2.6500 (2c)	=	137.3495	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	271.2943	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2500	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.2313	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.2000	4.1000	4.0000	4.2000	3.7000	3.9000	3.7000	3.7000	4.0000	3.9000	4.1000	(22)
Wind factor	1.1500	1.0500	1.0250	1.0000	1.0500	0.9250	0.9750	0.9250	0.9250	1.0000	0.9750	1.0250	(22a)
Adj infilt rate	0.2659	0.2428	0.2370	0.2313	0.2428	0.2139	0.2255	0.2139	0.2139	0.2313	0.2255	0.2370	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5159	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			2.1000	1.6000	3.3600			(26)
Windows (Uw = 1.40)			13.1700	1.3258	17.4602			(27)
French Doors (Uw = 1.50)			5.6700	1.4151	8.0236			(27)
Ground Floor			54.0100	0.1200	6.4812	75.0000	4050.7500	(28a)
External Walls	110.1600	20.9400	89.2200	0.1900	16.9518	60.0000	5353.2000	(29a)
Pitched Cold Roof	51.8300		51.8300	0.1000	5.1830	9.0000	466.4700	(30)
Bay Roof	2.1800		2.1800	0.1000	0.2180	9.0000	19.6200	(30)
Total net area of external elements Aum(A, m2)			218.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6778			(33)
Party Wall			53.4000	0.0000	0.0000	110.0000	5874.0000	(32)
Internal Wall - Masonry			46.6700			75.0000	3500.2500	(32c)
Internal Wall - Timber			84.2500			9.0000	758.2500	(32c)
Internal Floor			51.8300			18.0000	932.9400	(32d)
Internal Ceiling			51.8300			18.0000	932.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21888.4200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	206.8067	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8854	(36)
Total fabric heat loss	(33) + (36) = 73.5632	(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	46.1904	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	44.7636	(38)
Heat transfer coeff	119.7536	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	118.3268	(39)
Average = Sum(39)m / 12 =												118.4457	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1315	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	1.1180	(40)
HLP (average)												1.1191	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7874	(42)
Average daily hot water use (litres/day)	100.4010	(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.4411	106.4251	102.4091	98.3930	94.3770	90.3609	90.3609	94.3770	98.3930	102.4091	106.4251	110.4411	(44)
Energy conte	163.7810	143.2439	147.8149	128.8686	123.6525	106.7027	98.8757	113.4614	114.8164	133.8075	146.0613	158.6132	(45)
Energy content (annual)										Total = Sum(45)m =		1579.6992	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5672	21.4866	22.1722	19.3303	18.5479	16.0054	14.8314	17.0192	17.2225	20.0711	21.9092	23.7920	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	18.8421	16.9714	18.6809	17.9142	18.3666	17.6073	18.0903	18.2695	17.7745	18.5394	18.1087	18.7899	(61)
Total heat required for water heating calculated for each month													
	182.6232	160.2153	166.4958	146.7828	142.0191	124.3100	116.9661	131.7308	132.5910	152.3469	164.1701	177.4031	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1269.6808	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2133.0637	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3503	(H8)
Utilisation factor												0.5232	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.4010	(H14)
Volume ratio Veff/V												0.7470	(H15)
Solar storage volume factor												0.9417	(H16)
Solar input												-923.9938	(H17)
Solar input	-31.1194	-42.7056	-72.5551	-99.5145	-118.6523	-124.7889	-123.0954	-107.7961	-84.8498	-58.2648	-35.3970	-25.2549	(63)
								Solar input (sum of months) = Sum(63)m =				-923.9938	(63)
Output from w/h													
	151.5038	117.5097	93.9407	47.2683	23.3668	0.0000	0.0000	23.9347	47.7412	94.0821	128.7731	152.1482	(64)
								Total per year (kWh/year) = Sum(64)m =				880.2685	(64)
Heat gains from water heating, kWh/month													
	59.1677	51.8714	53.8187	47.3274	45.7061	39.8805	37.3988	42.2933	42.6201	49.1258	53.0926	57.4364	(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	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	167.2447	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5326	53.7645	43.7242	33.1021	24.7442	20.8901	22.5725	29.3405	39.3808	50.0030	58.3609	62.2150	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	396.1762	400.2873	389.9275	367.8728	340.0327	313.8669	296.3866	292.2755	302.6353	324.6900	352.5301	378.6959	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	54.5119	(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)													
	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	-111.4965	(71)
Water heating gains (Table 5)													
	79.5265	77.1896	72.3369	65.7324	61.4329	55.3896	50.2672	56.8458	59.1946	66.0294	73.7397	77.1994	(72)
Total internal gains													
	649.4955	644.5016	619.2488	579.9674	539.4700	503.4067	482.4864	491.7220	514.4708	553.9825	597.8908	631.3704	(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	6.3900	14.6401	0.6300	0.7000	0.7700	28.5901	(74)
East	0.9000	27.3735	0.6300	0.7000	0.7700	7.5291	(76)
South	2.8800	61.3950	0.6300	0.7000	0.7700	54.0377	(78)
West	3.0000	27.3735	0.6300	0.7000	0.7700	25.0971	(80)
South	5.6700	61.3950	0.6300	0.7000	0.7700	106.3868	(78)

Solar gains	221.6408	312.8001	435.9162	572.2033	637.7440	686.6868	657.8700	589.2837	508.6164	371.2684	254.9877	183.7266	(83)
Total gains	871.1363	957.3016	1055.1650	1152.1708	1177.2140	1190.0935	1140.3563	1081.0057	1023.0872	925.2509	852.8785	815.0970	(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	50.7719	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	51.3841	
alpha	4.3848	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	4.4256	
util living area													
	0.9813	0.9710	0.9408	0.8648	0.7176	0.5032	0.3405	0.3481	0.6196	0.8681	0.9620	0.9845	(86)
MIT	19.9422	20.0886	20.3621	20.6720	20.8946	20.9829	20.9977	20.9975	20.9580	20.7292	20.3063	19.9326	(87)
Th 2	19.9752	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	19.9862	(88)
util rest of house													
	0.9762	0.9633	0.9250	0.8298	0.6509	0.4112	0.2369	0.2390	0.5249	0.8242	0.9499	0.9801	(89)
MIT 2	19.0394	19.1913	19.4551	19.7405	19.9237	19.9799	19.9858	19.9858	19.9681	19.7975	19.4059	19.0392	(90)
Living area fraction									fLA = Living area / (4) =			0.2065	(91)

MIT	19.2259	19.3766	19.6424	19.9329	20.1242	20.1871	20.1948	20.1948	20.1725	19.9899	19.5919	19.2237	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0759	19.2266	19.4924	19.7829	19.9742	20.0371	20.0448	20.0448	20.0225	19.8399	19.4419	19.0737	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9560	0.9156	0.8217	0.6501	0.4159	0.2429	0.2453	0.5285	0.8168	0.9417	0.9749	(94)
Useful gains	845.3045	915.1483	966.1407	946.7320	765.2914	494.9776	277.0494	265.2149	540.6720	755.7001	803.1156	794.6299	(95)
Ext temp.	5.3000	5.7000	7.4000	9.9000	13.0000	15.8000	17.7000	17.8000	15.3000	12.0000	8.4000	5.5000	(96)
Heat loss rate W	1649.7123	1600.5574	1430.8601	1169.4102	825.2400	501.3620	277.4527	265.6170	558.8001	927.6686	1306.5536	1606.1338	(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	598.4794	460.5950	345.7513	160.3283	44.6018	0.0000	0.0000	0.0000	0.0000	127.9445	362.4754	603.7589	(98)
Space heating												2703.9345	(98)
Space heating per m2											(98) / (4) =	25.5474	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3004.3717	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	598.4794	460.5950	345.7513	160.3283	44.6018	0.0000	0.0000	0.0000	0.0000	127.9445	362.4754	603.7589	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	664.9771	511.7722	384.1681	178.1425	49.5575	0.0000	0.0000	0.0000	0.0000	142.1606	402.7504	670.8432	(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	151.5038	117.5097	93.9407	47.2683	23.3668	0.0000	0.0000	23.9347	47.7412	94.0821	128.7731	152.1482	(64)
Efficiency of water heater												87.0000	(216)
(217)m	89.3774	89.3736	89.3418	89.2989	88.9456	87.0000	87.0000	87.0000	87.0000	88.7039	89.1938	89.3796	(217)
Fuel for water heating, kWh/month	169.5102	131.4815	105.1475	52.9326	26.2709	0.0000	0.0000	27.5112	54.8749	106.0631	144.3745	170.2269	(219)
Water heating fuel used												988.3933	(219)

Annual totals kWh/year		
Space heating fuel - main system	3004.3717	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 10.0340, total flow = 37.0000, SFP = 0.2712)		
mechanical ventilation fans (SFP = 0.2712)	89.7579	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	214.7579	(231)
Electricity for lighting (calculated in Appendix L)	427.6098	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.76 * 1246 * 1.00) =	-757.5778	-757.5778 (233)
Total delivered energy for all uses		3877.5550 (238)

10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3004.3717	3.6300	109.0587	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.3933	3.6300	35.8787	(247)
Mechanical ventilation fans	89.7579	19.4400	17.4489	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	427.6098	19.4400	83.1273	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-757.5778	19.4400	-147.2731	(252)
Total energy cost			217.5405	(255)

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

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

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

Space heating - main system 1	3004.3717	0.2160	648.9443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3933	0.2160	213.4930	(264)
Space and water heating			862.4372	(265)
Pumps and fans	214.7579	0.5190	111.4594	(267)
Energy for lighting	427.6098	0.5190	221.9295	(268)
Energy saving/generation technologies				
PV Unit	-757.5778	0.5190	-393.1829	(269)
Total kg/year			802.6432	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3004.3717	1.2200	3665.3335	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.3933	1.2200	1205.8398	(264)
Space and water heating			4871.1733	(265)
Pumps and fans	214.7579	3.0700	659.3069	(267)
Energy for lighting	427.6098	3.0700	1312.7621	(268)
Energy saving/generation technologies				
PV Unit	-757.5778	3.0700	-2325.7638	(269)
Primary energy kWh/year			4517.4785	(272)
Primary energy kWh/m2/year			42.6821	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	206.8 (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	716.22	(P1)
Transmission heat loss coefficient	73.56	(37)
Summer heat loss coefficient	789.78	(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)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.3900	87.1704	0.6300	0.7000	0.9000	198.9728
East	0.9000	125.2818	0.6300	0.7000	0.9000	40.2767
South	2.8800	118.5567	0.6300	0.7000	0.9000	121.9669
West	3.0000	125.2818	0.6300	0.7000	0.9000	134.2557
South	5.6700	118.5567	0.6300	0.7000	0.9000	240.1224
total:						735.5946

	Jun	Jul	Aug	
Solar gains	786	736	671	(P3)
Internal gains	500	479	489	
Total summer gains	1287	1215	1160	(P5)
Summer gain/loss ratio	1.63	1.54	1.47	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 206.8)	0.55	0.55	0.55	
Threshold temperature	17.58	19.39	19.32	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

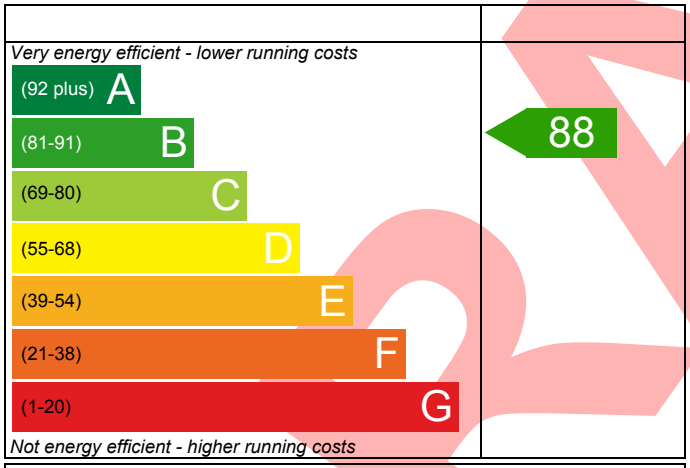
Plot 6, Long Copse Lane,
Emsworth,
Hampshire,
PO10 7UR

Dwelling type:	House, Semi-Detached
Date of assessment:	10/05/2022
Produced by:	Scott Spearing
Total floor area:	105.84 m²

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

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

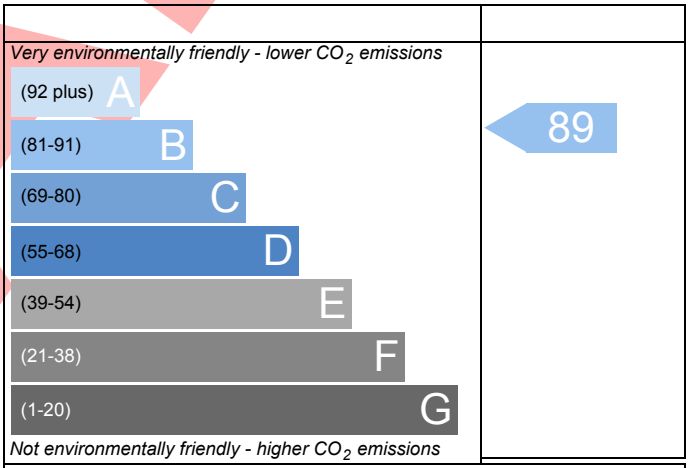
Energy Efficiency Rating



England EU Directive 2002/91/EC

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

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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

DRAFT

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.