

Energy Calculations Ltd

SAP ♦ CODE ♦ SBEM ♦ DESIGN

01754-761035



SAP Report Submission for Building Regulations Compliance

Client:

Project: Adj., 20, Venetia Close
READING, Emmer Green, RG4 8UG

Contact: Matthew Carter
Energy Calculations Limited
mcarter@energycalculations.co.uk

Report Issue Date: 22/05/2017

EXCELLENCE
IN ENERGY
ASSESSMENT

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP • CODE • SBEM • DESIGN

Property Reference	005151	Issued on Date	22/05/2017
Survey Reference	001	Prop Type Ref	
Property	Adj., 20, Venetia Close, Emmer Green, READING, RG4 8UG		
SAP Rating	83 B	DER	18.55
Environmental	84 B	TER	18.70
CO ₂ Emissions (t/year)	1.83	% DER<TER	0.81
General Requirements Compliance	Pass	DfEE	60.13
		TFEE	63.87
		% DfEE<TFEE	5.86
Surveyor	Matthew Carter, Tel: 01754 761035	Surveyor ID	7869-0001
Client			

SUMMARY 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)	18.70	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	18.55	kgCO ₂ /m ²	Pass
	-0.15 (-0.8%)	kgCO ₂ /m ²	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.87	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DFEE)	60.13	kWh/m ² /yr	
	-3.8 (-5.9%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	Pass
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	Pass
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.50 (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 Home Combi 35 Combi boiler Efficiency: 89.3% SEDBUK2009 Minimum: 88.0%	Pass
Secondary heating system	None	

BUILDING REGULATION COMPLIANCE

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5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)

Not significant

Pass

Based on:

Overshading

Average

Windows facing North

9.06 m², No overhang

Windows facing South

12.26 m², No overhang

Windows facing West

2.25 m², No overhang

Air change rate

8.00 ach

Blinds/curtains

None

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

5.50 (design value)

Maximum

10.0

Pass

10 Key features

None

N/A

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General Requirements Compliance	Pass	DfEE	60.13
		TfEE	63.87
		% DfEE<TfEE	5.86
Surveyor	Matthew Carter, Tel: 01754 761035	Surveyor ID	7869-0001
Client			

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

Orientation	North
Property Tenure	Unknown
Transaction Type	New dwelling
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2017
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Ground Floor:	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	1st Storey:	37.10 m	57.87 m ²	2.41 m
		37.10 m	57.87 m ²	2.74 m
7.0 Living Area	23.32	m ²		
8.0 Thermal Mass Parameter	Precise calculation			
Thermal Mass	262.95	kJ/m ² K		

9.0 External Walls

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Main walls	Cavity Wall	Cavity wall : plasterboard on dabs, dense block, filled cavity, any outside structure	0.18	150.00	170.51	137.54

9.2 Internal Walls

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Wall 1	Plasterboard on timber frame	9.00	52.00
Internal Wall 2	Plasterboard on timber frame	9.00	98.37

10.0 External Roofs

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Slope	External Slope Roof	Other	0.13	0.00	78.52	71.43

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	57.87

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m ² K)	Kappa (kJ/m ² K)	Area (m ²)
Heat Loss Floor 1	Ground Floor - Solid	Slab on ground, screed over insulation	0.14	110.00	57.87

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	57.87

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	Solar Trans	Frame Type	Frame Factor	U Value (W/m²K)
Doors	Manufacture	Half Glazed Door	Double Low-E Soft 0.05			0.63		0.70	1.40
Windows	Manufacture	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Roof lights	Manufacture	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Half Glazed Door	[1] Main walls	North							2.10	
Front Windows	Window	[1] Main walls	North	None	0.00					9.06	
Side Windows	Half Glazed Door	[1] Main walls	East							7.30	
Side R lights	Roof Window	[1] Slope	East	None						5.49	
Side Windows	Window	[1] Main walls	West	None	0.00					2.25	
Side R lights	Roof Window	[1] Slope	West	None						1.60	
Rear Windows	Window	[1] Main walls	South	None	0.00					12.26	

14.0 Conservatory

15.0 Draught Proofing

 %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	25.60	0.300	No
Table K1 - Approved	E3 Sill	20.80	0.040	No
Table K1 - Approved	E4 Jamb	49.36	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	37.10	0.160	No
Table K1 - Approved	E6 Intermediate floor within a dwelling	37.10	0.070	No
Table K1 - Approved	E11 Eaves (insulation at rafter level)	34.36	0.040	No
Table K1 - Approved	E13 Gable (insulation at rafter level)	18.28	0.040	No
Table K1 - Approved	E16 Corner (normal)	25.14	0.090	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	8.38	-0.090	No
Table K1 - Default	R1 Head of roof window	2.56	0.080	No
Table K1 - Default	R2 Sill of roof window	2.56	0.060	No
Table K1 - Default	R3 Jamb of roof window	5.61	0.080	No
Table K1 - Default	R4 Ridge (vaulted ceiling)	17.00	0.080	No
Table K1 - Default	R5 Ridge (inverted)	5.09	0.040	No

Y-value	0.083	W/m²K
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18.0 Pressure Testing

Designed q50	5.50	m³/m²/hr @ 50 Pa
Property Tested ?		
As Built q50		m³/m²/hr @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes

SUMMARY FOR INPUT DATA

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Night Ventilation

Air change rate

Mechanical Ventilation

Mechanical Ventilation System Present

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				4
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System

22.0 Lighting

Internal

Total number of light fittings

Total number of L.E.L. fittings

Percentage of L.E.L. fittings %

External

External lights fitted

23.0 Electricity Tariff

24.0 Main Heating 1

Percentage of Heat %

Database Ref. No.

Fuel Type

Main Heating

SAP Code

In Winter

In Summer

Controls

PCDF Controls

Delayed Start Stat

Sap Code

Flue Type

Fan Assisted Flue

Is MHS Pumped

Heat Emitter

Flow Temperature

Combi boiler type

Combi keep hot type

25.0 Main Heating 2

28.0 Water Heating

Water Heating

Flue Gas Heat Recovery System

Waste Water Heat Recovery

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Instantaneous System 1

Waste Water Heat Recovery

No

Instantaneous System 2

Waste Water Heat Recovery

No

Storage System

Solar Panel

No

Water use <= 125 litres/person/day

Yes

SAP Code

901

29.0 Hot Water Cylinder

None

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	£35	B 84	
	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar photovoltaic panels, 2.5 kWp	£5,000 - £8,000	£289	A 92	

FULL SAP CALCULATION PRINTOUT

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Environmental	84 B	% DER<TER	0.81		
CO ₂ Emissions (t/year)	1.83	DFEE	60.13	TFEE	63.87
General Requirements Compliance	Pass	% DFEE<TFEE	5.86		
Surveyor	Matthew Carter, Tel: 01754 761035			Surveyor ID	7869-0001
Client					

SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (House)	22/05/2017
FullRefNo:	001
Regs Region:	England
SAP Region:	Thames Valley
Postcode:	RG4 8UG
DwellingOrientation:	North
Property Type:	House, Detached
Storeys:	2
Date Built:	2017
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	37.1, 57.87, 2.41
2nd Storey:	37.1, 57.87, 2.74
Living Area:	23.32 m2, fraction: 20.1%
Thermal Mass:	Precise calculation
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Main walls	137.54, 170.51, 150, CavityWallPlasterOnDabsDenseBlock, Cavity, 0, 0.18, Gross
Internal Walls	Area, Kappa
Internal Wall 1	52, 9
Internal Wall 2	98.37, 9
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Slope	71.43, 78.52, 0, Other, 0.13
Internal Ceilings	Area, Kappa, Construction, Element
Internal Ceiling 1	57.87, 18, Plasterboard ceiling, carpeted chipboard floor
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Heat Loss Floor 1	57.87, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.14
Internal Floors	Area, Kappa, Construction, Element
Internal Floor 1	57.87, 18, Plasterboard ceiling, carpeted chipboard floor
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Doors	Manufacturer, Half Glazed Door, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Windows	Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Roof lights	Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Front Door	Half Glazed Door, Main walls, North, , , , 0, 0, 0, 2.10,
Front Windows	Window, Main walls, North, , None, 0, , 0, 0, 9.06,
Side Windows	Half Glazed Door, Main walls, East, , , , 0, 0, 0, 7.30,
Side R lights	Roof Window, Slope, East, 10, None, , , 0, 0, 0, 5.49,
Side Windows	Window, Main walls, West, , None, 0, , 0, 0, 2.25,
Side R lights	Roof Window, Slope, West, 10, None, , , 0, 0, 0, 1.60,
Rear Windows	Window, Main walls, South, , None, 0, , 0, 0, 12.26,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.083
List of Bridges	Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0.	External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
1.	External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, No, 25.6, 0.3, 0.3, 7.68,
2.	External wall, E3 Sill, Table K1 - Approved, No, 20.8, 0.04, 0.04, 0.83,
3.	External wall, E4 Jamb, Table K1 - Approved, No, 49.36, 0.05, 0.05, 2.47,
4.	External wall, E5 Ground floor (normal), Table K1 - Approved, No, 37.1, 0.16, 0.16, 5.94,
5.	External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
6.	External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
7.	External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
8.	External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
9.	External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, No, 37.1, 0.07, 0.07, 2.60,
10.	External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
11.	External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
12.	External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
13.	External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation, , No, 0, 0, 0, 0.00,
14.	External wall, E10 Eaves (insulation at ceiling level), , No, 0, 0, 0, 0.00,
15.	External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
16.	External wall, E11 Eaves (insulation at rafter level), Table K1 - Approved, No, 34.36, 0.04, 0.04, 1.37,
17.	External wall, E12 Gable (insulation at ceiling level), , No, 0, 0, 0, 0.00,
18.	External wall, E13 Gable (insulation at rafter level), Table K1 - Approved, No, 18.28, 0.04, 0.04, 0.73,
19.	External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
20.	External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21.	External wall, E16 Corner (normal), Table K1 - Approved, No, 25.14, 0.09, 0.09, 2.26,
22.	External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 8.38, -0.09, -0.09, -
0.75,	
23.	External wall, E18 Party wall between dwellings, , No, 0, 0, 0, 0.00,
24.	External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25.	Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
26.	Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
27.	Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
28.	Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,

FULL SAP CALCULATION PRINTOUT

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SAP2012 - 9.92 input data (DesignData) -

29. Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
30. Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
31. Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
32. Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
33. External roof, R1 Head of roof window, Table K1 - Default, No, 2.56, 0.08, 0.08, 0.20,
34. External roof, R2 Sill of roof window, Table K1 - Default, No, 2.56, 0.06, 0.06, 0.15,
35. External roof, R3 Jamb of roof window, Table K1 - Default, No, 5.61, 0.08, 0.08, 0.45,
36. External roof, R4 Ridge (vaulted ceiling), Table K1 - Default, No, 17, 0.08, 0.08, 1.36,
37. External roof, R5 Ridge (inverted), Table K1 - Default, No, 5.09, 0.04, 0.04, 0.20,
38. External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39. External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40. External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41. External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test: True
Designed q50: 5.5
AsBuilt q50: 15
Property Tested: False
Mechanical Ventilation None
Chimneys MHS: 0
Chimneys SHS: 0
Chimneys Other: 0
Chimneys Total: 0
Open Flues MHS: 0
Open Flues SHS: 0
Open Flues Other: 0
Open Flues Total: 0
Intermittent Fans: 4
Passive Vents: 0
Flueless Gas Fires: 0
Cooling System None
Light Fittings: 9
LEL Fittings: 9
Percentage of LEL Fittings: 100
External Lights Fitted: No
External LELs Fitted: No
Electricity Tariff: Standard
Main Heating 1
Description
Percentage 100
Sedbuk ID 17838
Fuel Type Mains gas
MHS Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code 104
Boiler Efficiency Type Split Efficiencies
Efficiency Winter 90.2
Efficiency Summer 87.3
Controls by PCDF 0
MHS Controls CBI Time and temperature zone control
Boiler Interlock Yes
Compensator 0
Delayed Start Stat Yes
Ctrl SAP Code 2110
Flue Type Balanced
Fan Assisted Flue Yes
Pumped Pump in heated space
Heat Pump Age 2013 or later
Heat Emitter Radiators
Flow Temperature Normal (> 45°C)
Combi boiler type Standard Combi
Combi keep hot type Gas/Oil, time clock
Main Heating 2 None
Heating Systems Interaction Each system heats separate parts of dwelling
Smoke Control Area Unknown
Community Heating None
Secondary Heating None
Water Heating
Type MainHeating1
WHS HWP From main heating 1
Low Water Usage Yes
SAP Code 901
Showers in Property Non-electric only
Hot Water Cylinder None
Flue Gas Heat Recovery System None
Waste Water Heat Recovery none
PV Unit None
Wind Turbine None
Terrain Type: Urban
Small Scale Hydro None
Special Features None

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

DWELLING AS DESIGNED

Detached House, total floor area 116 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) 18.70 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.55 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 63.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 60.1 kWh/m²/yrOK

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Fabric U-values			
Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

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

3 Air permeability			
Air permeability at 50 pascals:	5.50 (design value)		
Maximum	10.0		OK

4 Heating efficiency			
Main heating system:	Boiler system with radiators or underfloor - Mains gas		
Data from database			
Vaillant Home Combi 35			
Combi boiler			
Efficiency: 89.3% SEDBUK2009			
Minimum: 88.0%	OK		

Secondary heating system:	None		

5 Cylinder insulation			
Hot water storage	No cylinder		

6 Controls			
Space heating controls:	Time and temperature zone control		OK

Hot water controls:	No cylinder		

Boiler interlock	Yes		OK

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

8 Mechanical ventilation			
Not applicable			

9 Summertime temperature			
Overheating risk (Thames Valley):	Not significant		OK
Based on:			
Overshading:	Average		
Windows facing North:	9.06 m², No overhang		
Windows facing South:	12.26 m², No overhang		
Windows facing West:	2.25 m², No overhang		
Air change rate:	8.00 ach		
Blinds/curtains:	None		

10 Key features			
None			

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3478 (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	0.4435	0.4348	0.4261	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087 (22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5518	0.5605	0.5699	0.5766	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	58.8468	58.4712	58.1031	56.3740	56.0505	54.5445	54.5445	54.2656	55.1246	56.0505	56.7049	57.3891 (38)
Heat transfer coeff	180.2972	179.9216	179.5535	177.8244	177.5009	175.9949	175.9949	175.7160	176.5750	177.5009	178.1554	178.8396 (39)
Average = Sum(39)m / 12 =												177.8229 (39)
HLP	1.5578	1.5545	1.5514	1.5364	1.5336	1.5206	1.5206	1.5182	1.5256	1.5336	1.5393	1.5452 (40)
HLP (average)												1.5364 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
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Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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)
Output from w/h	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (64)
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1750.4822 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)m
(66)m	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.9229	22.1363	18.0024	13.6290	10.1878	8.6010	9.2937	12.0803	16.2141	20.5875	24.0287	25.6155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	279.5587	282.4596	275.1493	259.5866	239.9414	221.4778	209.1429	206.2420	213.5522	229.1150	248.7601	267.2238	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	(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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	(71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527	(72)
Total internal gains	451.6617	449.4173	433.0750	406.4792	379.0622	352.9184	336.1035	342.6237	356.4302	383.2591	414.1279	437.6706	(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			9.0600		10.6334		0.6300		0.7000		0.7700		29.4423 (74)
South			12.2600		46.7521		0.6300		0.7000		0.7700		175.1714 (78)
West			2.2500		19.6403		0.6300		0.7000		0.7700		13.5052 (80)
East			5.4900		26.4442		0.6300		0.7000		1.0000		57.6215 (82)
West			1.6000		26.4442		0.6300		0.7000		1.0000		16.7932 (82)
Solar gains	292.5335	522.5971	774.1279	1049.2886	1251.0695	1273.6284	1214.8880	1060.6605	869.4379	594.0410	354.9463	247.3262	(83)
Total gains	744.1952	972.0144	1207.2029	1455.7678	1630.1317	1626.5468	1550.9915	1403.2842	1225.8681	977.3001	769.0743	684.9968	(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	46.8876	46.9855	47.0818	47.5396	47.6263	48.0338	48.0338	48.1101	47.8760	47.6263	47.4513	47.2698	
alpha	4.1258	4.1324	4.1388	4.1693	4.1751	4.2023	4.2023	4.2073	4.1917	4.1751	4.1634	4.1513	
util living area	0.9976	0.9927	0.9773	0.9269	0.8118	0.6391	0.4854	0.5506	0.8049	0.9657	0.9947	0.9983 (86)	
MIT	19.3494	19.5936	19.9630	20.4141	20.7608	20.9365	20.9842	20.9739	20.8305	20.3409	19.7510	19.3080 (87)	
Th 2	19.6444	19.6468	19.6492	19.6603	19.6624	19.6721	19.6721	19.6739	19.6683	19.6624	19.6582	19.6538 (88)	
util rest of house	0.9968	0.9899	0.9686	0.8989	0.7453	0.5280	0.3459	0.4042	0.7097	0.9470	0.9923	0.9977 (89)	
MIT 2	17.4866	17.8438	18.3779	19.0134	19.4501	19.6358	19.6676	19.6652	19.5470	18.9315	18.0824	17.4322 (90)	
Living area fraction									fLA = Living area / (4) =			0.2015 (91)	
MIT	17.8620	18.1963	18.6972	19.2956	19.7142	19.8979	19.9329	19.9289	19.8056	19.2155	18.4186	17.8102 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	17.7120	18.0463	18.5472	19.1456	19.5642	19.7479	19.7829	19.7789	19.6556	19.0655	18.2686	17.6602 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	740.2013	957.3457	1156.9681	1288.5157	1205.7353	869.9585	555.1854	584.4417	868.6681	913.7371	759.9918	682.3359 (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	2418.1396	2365.3113	2163.1227	1821.9247	1395.9069	905.9962	560.1657	593.7306	980.9871	1502.6316	1989.7454	2407.2095 (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	1248.3861	946.1529	748.5790	384.0545	141.4877	0.0000	0.0000	0.0000	0.0000	438.1375	885.4226	1283.3060 (98)	
Space heating												6075.5263 (98)	
Space heating per m2												(98) / (4) = 52.4929 (99)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												6735.6167 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1248.3861	946.1529	748.5790	384.0545	141.4877	0.0000	0.0000	0.0000	0.0000	438.1375	885.4226	1283.3060 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	1384.0201	1048.9500	829.9102	425.7810	156.8599	0.0000	0.0000	0.0000	0.0000	485.7400	981.6215	1422.7339 (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 requirement	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (64)
Efficiency of water heater (217)m	89.8261	89.7761	89.6685	89.3947	88.7446	87.3000	87.3000	87.3000	87.3000	89.4485	89.7428	87.3000 (216)
Fuel for water heating, kWh/month	199.0888	174.6064	181.3100	159.8493	155.4499	137.7896	129.1112	146.1391	147.2966	165.8121	178.7363	193.1919 (219)
Water heating fuel used												1968.3812 (219)
Annual totals kWh/year												
Space heating fuel - main system												6735.6167 (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)												440.1455 (232)
Total delivered energy for all uses												9219.1433 (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	6735.6167	0.2160	1454.8932 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1968.3812	0.2160	425.1703 (264)
Space and water heating			1880.0635 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	440.1455	0.5190	228.4355 (268)
Total CO2, kg/year			2147.4240 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.5500 (273)

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

DER		18.5500 ZC1
Total Floor Area	TFA	115.7400
Assumed number of occupants	N	2.8452
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		14.3132 ZC2
CO2 emissions from cooking, equation (L16)		1.6182 ZC3
Total CO2 emissions		34.4813 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		34.4813 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
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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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q ₅₀					5.0000
Infiltration rate					0.3842 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3266 (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	0.4164	0.4082	0.4001	0.3592	0.3511	0.3103	0.3103	0.3021	0.3266	0.3511	0.3674	0.3837 (22b)
Effective ac	0.5867	0.5833	0.5800	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5675	0.5736 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			9.4000	1.2000	11.2800		(26a)
TER Opening Type (U _w = 1.40)			15.0100	1.3258	19.8996		(27)
TER Room Window (U _w = 1.70)			4.5200	1.5918	7.1948		(27a)
Heat Loss Floor 1			57.8700	0.1300	7.5231		(28a)
Main walls	170.5100	24.4100	146.1000	0.1800	26.2980		(29a)
Slope	78.5200	4.5200	74.0000	0.1300	9.6200		(30)
Total net area of external elements A _{um} (m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.8155		(33)
Thermal mass parameter (TMP = C _m / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.4400 (36)
Total fabric heat loss						(33) + (36) =	99.2555 (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	57.7011	57.3701	57.0455	55.5213	55.2361	53.9085	53.9085	53.6626	54.4198	55.2361	55.8130	56.4162 (38)
Heat transfer coeff	156.9566	156.6255	156.3010	154.7767	154.4915	153.1640	153.1640	152.9181	153.6753	154.4915	155.0685	155.6716 (39)
Average = Sum(39)m / 12 =												154.7754 (39)
HLP	1.3561	1.3533	1.3504	1.3373	1.3348	1.3233	1.3233	1.3212	1.3278	1.3348	1.3398	1.3450 (40)
HLP (average)												1.3373 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP • CODE • SBEM • DESIGN

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	49.1863	48.7513	45.1711	46.6768	48.7513	49.1863	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	216.9802	191.2307	200.7957	179.8176	174.0952	153.3333	146.9050	163.7646	165.5732	186.5967	197.3743	211.7417 (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)
Output from w/h	216.9802	191.2307	200.7957	179.8176	174.0952	153.3333	146.9050	163.7646	165.5732	186.5967	197.3743	211.7417 (64)
Heat gains from water heating, kWh/month	67.9418	59.7869	62.5605	55.7315	53.8647	47.2567	44.9951	50.4298	50.9952	57.8393	61.5585	66.2000 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.5313	22.6766	18.4419	13.9617	10.4365	8.8110	9.5205	12.3752	16.6099	21.0901	24.6153	26.2408 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	279.5587	282.4596	275.1493	259.5866	239.9414	221.4778	209.1429	206.2420	213.5522	229.1150	248.7601	267.2238 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262 (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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095 (71)
Water heating gains (Table 5)	91.3196	88.9687	84.0866	77.4048	72.3987	65.6343	60.4773	67.7819	70.8267	77.7410	85.4979	88.9785 (72)
Total internal gains	465.0881	462.7834	446.3564	419.6317	391.4553	364.6016	347.8192	355.0776	369.6674	396.6246	427.5518	451.1217 (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				5.7700	10.6334	0.6300		0.7000		0.7700		18.7508 (74)
South				7.8100	46.7521	0.6300		0.7000		0.7700		111.5896 (78)
West				1.4300	19.6403	0.6300		0.7000		0.7700		8.5833 (80)
East				3.5000	26.4442	0.6300		0.7000		1.0000		36.7350 (82)
West				1.0200	26.4442	0.6300		0.7000		1.0000		10.7056 (82)
Solar gains	186.3643	332.9367	493.1946	668.5143	797.0819	811.4583	774.0320	675.7638	553.9220	378.4558	226.1268	157.5634 (83)
Total gains	651.4524	795.7202	939.5510	1088.1460	1188.5372	1176.0599	1121.8512	1030.8414	923.5894	775.0804	653.6786	608.6850 (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	51.2084	51.3167	51.4232	51.9296	52.0255	52.4764	52.4764	52.5608	52.3018	52.0255	51.8319	51.6311
alpha	4.4139	4.4211	4.4282	4.4620	4.4684	4.4984	4.4984	4.5041	4.4868	4.4684	4.4555	4.4421
util living area	0.9984	0.9958	0.9880	0.9608	0.8853	0.7368	0.5749	0.6382	0.8693	0.9797	0.9966	0.9988 (86)
MIT	19.4587	19.6469	19.9525	20.3509	20.6981	20.9106	20.9772	20.9642	20.7976	20.3348	19.8204	19.4271 (87)
Th 2	19.7971	19.7994	19.8015	19.8117	19.8137	19.8226	19.8226	19.8242	19.8191	19.8137	19.8098	19.8057 (88)
util rest of house	0.9978	0.9943	0.9835	0.9450	0.8382	0.6365	0.4338	0.4958	0.7969	0.9688	0.9951	0.9984 (89)
MIT 2	17.7555	18.0317	18.4772	19.0525	19.5178	19.7634	19.8146	19.8099	19.6547	19.0404	18.2930	17.7150 (90)
Living area fraction	18.0987	18.3571	18.7745	19.3141	19.7557	19.9946	20.0488	20.0424	19.8850	19.3012	18.6007	18.0600 (92)
Temperature adjustment	18.0987	18.3571	18.7745	19.3141	19.7557	19.9946	20.0488	20.0424	19.8850	19.3012	18.6007	18.0600 (93)
adjusted MIT	18.0987	18.3571	18.7745	19.3141	19.7557	19.9946	20.0488	20.0424	19.8850	19.3012	18.6007	18.0600 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	649.1812	789.0101	918.8073	1018.7925	992.9324	767.6212	518.6460	540.4326	740.5360	745.6027	648.9269	607.1015 (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	2165.7942	2107.7280	1918.5105	1611.8647	1244.5311	826.2517	528.2377	556.9940	889.0049	1344.2579	1783.3964	2157.6030 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1128.3601	886.1785	743.7792	427.0120	187.1894	0.0000	0.0000	0.0000	0.0000	445.3995	816.8180	1153.5731 (98)
Space heating												5788.3097 (98)
Space heating per m2												50.0113 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
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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													6197.3337	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1128.3601	886.1785	743.7792	427.0120	187.1894	0.0000	0.0000	0.0000	0.0000	445.3995	816.8180	1153.5731	(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)	1208.0943	948.7992	796.3374	457.1863	200.4169	0.0000	0.0000	0.0000	0.0000	476.8731	874.5375	1235.0890	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	216.9802	191.2307	200.7957	179.8176	174.0952	153.3333	146.9050	163.7646	165.5732	186.5967	197.3743	211.7417	(64)	
Efficiency of water heater (217)m	88.6026	88.4259	88.0459	87.1518	85.2340	80.3000	80.3000	80.3000	80.3000	87.1631	88.2401	88.6704	(216)	
Fuel for water heating, kWh/month	244.8914	216.2609	228.0581	206.3270	204.2556	190.9506	182.9452	203.9410	206.1933	214.0776	223.6788	238.7964	(219)	
Water heating fuel used												2560.3759	(219)	
Annual totals kWh/year														
Space heating fuel - main system													6197.3337	(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)													450.8899	(232)
Total delivered energy for all uses													9283.5995	(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	6197.3337	0.2160	1338.6241 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2560.3759	0.2160	553.0412 (264)
Space and water heating			1891.6653 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	450.8899	0.5190	234.0119 (268)
Total CO2, kg/m2/year			2164.6021 (272)
Emissions per m2 for space and water heating			16.3441 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0219 (272b)
Emissions per m2 for pumps and fans			0.3363 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3441 * 1.00) + 2.0219 + 0.3363, rounded to 2 d.p.			18.7000 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3478 (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	0.4435	0.4348	0.4261	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087 (22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5518	0.5605	0.5699	0.5766	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			9.0000	520.8300 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 29912.5200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 258.4458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	58.8468	58.4712	58.1031	56.3740	56.0505	54.5445	54.5445	54.2656	55.1246	56.0505	56.7049	57.3891 (38)
Heat transfer coeff	180.2972	179.9216	179.5535	177.8244	177.5009	175.9949	175.9949	175.7160	176.5750	177.5009	178.1554	178.8396 (39)
Average = Sum(39)m / 12 =												177.8229 (39)
HLP	1.5578	1.5545	1.5514	1.5364	1.5336	1.5206	1.5206	1.5182	1.5256	1.5336	1.5393	1.5452 (40)
HLP (average)												1.5364 (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 2.8452 (42)
Average daily hot water use (litres/day) 101.7744 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy conte	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
Energy content (annual)										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

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Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.2795	30.8557	31.8403	27.7592	26.6356	22.9845	21.2985	24.4403	24.7322	28.8230	31.4626	34.1663 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.9229	22.1363	18.0024	13.6290	10.1878	8.6010	9.2937	12.0803	16.2141	20.5875	24.0287	25.6155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	279.5587	282.4596	275.1493	259.5866	239.9414	221.4778	209.1429	206.2420	213.5522	229.1150	248.7601	267.2238	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	(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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	(71)
Water heating gains (Table 5)	47.4187	45.9162	42.7961	38.5544	35.8005	31.9229	28.6270	32.8499	34.3503	38.7406	43.6980	45.9225	(72)
Total internal gains	417.5788	416.1906	401.6264	377.4485	351.6083	327.6802	312.7421	316.8507	329.7952	354.1217	382.1654	404.4404	(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				9.0600	10.6334		0.6300		0.7000		0.7700		29.4423 (74)
South				12.2600	46.7521		0.6300		0.7000		0.7700		175.1714 (78)
West				2.2500	19.6403		0.6300		0.7000		0.7700		13.5052 (80)
East				5.4900	26.4442		0.6300		0.7000		1.0000		57.6215 (82)
West				1.6000	26.4442		0.6300		0.7000		1.0000		16.7932 (82)
Solar gains	292.5335	522.5971	774.1279	1049.2886	1251.0695	1273.6284	1214.8880	1060.6605	869.4379	594.0410	354.9463	247.3262	(83)
Total gains	710.1123	938.7877	1175.7544	1426.7371	1602.6778	1601.3086	1527.6301	1377.5112	1199.2331	948.1627	737.1118	651.7666	(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	46.0852	46.1814	46.2761	46.7261	46.8112	47.2118	47.2118	47.2867	47.0567	46.8112	46.6393	46.4608	
alpha	4.0723	4.0788	4.0851	4.1151	4.1207	4.1475	4.1475	4.1524	4.1371	4.1207	4.1093	4.0974	
util living area	0.9979	0.9932	0.9783	0.9292	0.8164	0.6454	0.4915	0.5585	0.8117	0.9677	0.9952	0.9985	(86)
MIT	19.3031	19.5514	19.9278	20.3891	20.7467	20.9312	20.9826	20.9711	20.8185	20.3130	19.7116	19.2617	(87)
Th 2	19.6444	19.6468	19.6492	19.6603	19.6624	19.6721	19.6721	19.6739	19.6683	19.6624	19.6582	19.6538	(88)
util rest of house	0.9971	0.9906	0.9700	0.9022	0.7511	0.5345	0.3508	0.4111	0.7183	0.9502	0.9930	0.9979	(89)
MIT 2	18.1273	18.3761	18.7488	19.1971	19.5073	19.6448	19.6686	19.6672	19.5781	19.1387	18.5453	18.0930	(90)
Living area fraction	18.3642	18.6129	18.9863	19.4373	19.7571	19.9040	19.9333	19.9299	19.8280	19.3753	18.7803	18.3285	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3642	18.6129	18.9863	19.4373	19.7571	19.9040	19.9333	19.9299	19.8280	19.3753	18.7803	18.3285	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9960	0.9879	0.9646	0.8967	0.7564	0.5553	0.3795	0.4411	0.7314	0.9451	0.9909	0.9971	(94)
Ext temp.	707.2401	927.4062	1134.1576	1279.2849	1212.2568	889.2005	579.7737	607.6423	877.1606	896.0887	730.3874	649.8882	(95)
Heat loss rate W	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)
Month fracti	2535.7348	2467.2460	2241.9601	1873.7856	1430.1353	933.4712	586.6484	620.2602	1011.4259	1557.6278	2080.9039	2526.7261	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating	1360.4001	1034.7723	824.2050	428.0405	162.1016	0.0000	0.0000	0.0000	0.0000	492.1850	972.3718	1396.3674	(98)
Space heating per m2												6670.4438	(98)
												57.6330	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1654.3524	1302.3625	1335.4420	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8554	0.9118	0.8804	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1415.1049	1187.5352	1175.6776	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1890.2000	1806.7548	1648.3974	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	342.0685	460.6994	351.7036	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1154.4715 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	85.5171	115.1748	87.9259	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												288.6179 (107)
Energy for space heating												2.4937 (108)
Energy for space cooling												57.6330 (99)
Total												2.4937 (108)
Dwelling Fabric Energy Efficiency (DFEE)												60.1267 (109)
												60.1 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3842 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3266 (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	0.4164	0.4082	0.4001	0.3592	0.3511	0.3103	0.3103	0.3021	0.3266	0.3511	0.3674	0.3837 (22b)
Effective ac	0.5867	0.5833	0.5800	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5675	0.5736 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Semi-glazed door			9.4000	1.2000	11.2800		(26a)
TER Opening Type (Uw = 1.40)			15.0100	1.3258	19.8996		(27)
TER Room Window (Uw = 1.70)			4.5200	1.5918	7.1948		(27a)
Heat Loss Floor 1			57.8700	0.1300	7.5231		(28a)
Main walls	170.5100	24.4100	146.1000	0.1800	26.2980		(29a)
Slope	78.5200	4.5200	74.0000	0.1300	9.6200		(30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		81.8155		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.4400 (36)
Total fabric heat loss						(33) + (36) =	99.2555 (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	57.7011	57.3701	57.0455	55.5213	55.2361	53.9085	53.9085	53.6626	54.4198	55.2361	55.8130	56.4162 (38)
Heat transfer coeff	156.9566	156.6255	156.3010	154.7767	154.4915	153.1640	153.1640	152.9181	153.6753	154.4915	155.0685	155.6716 (39)
Average = Sum(39)m / 12 =												154.7754 (39)
HLP	1.3561	1.3533	1.3504	1.3373	1.3348	1.3233	1.3233	1.3212	1.3278	1.3348	1.3398	1.3450 (40)
HLP (average)												1.3373 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1601.3070 (45)
Water 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 (46)
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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 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)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.2795	30.8557	31.8403	27.7592	26.6356	22.9845	21.2985	24.4403	24.7322	28.8230	31.4626	34.1663 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	142.2618	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.5313	22.6766	18.4419	13.9617	10.4365	8.8110	9.5205	12.3752	16.6099	21.0901	24.6153	26.2408	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	279.5587	282.4596	275.1493	259.5866	239.9414	221.4778	209.1429	206.2420	213.5522	229.1150	248.7601	267.2238	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	37.2262	(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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	(71)
Water heating gains (Table 5)	47.4187	45.9162	42.7961	38.5544	35.8005	31.9229	28.6270	32.8499	34.3503	38.7406	43.6980	45.9225	(72)
Total internal gains	418.1872	416.7310	402.0659	377.7812	351.8570	327.8901	312.9690	317.1456	330.1910	354.6243	382.7520	405.0657	(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	5.7700	10.6334	0.6300	0.7000	0.7700	18.7508	(74)
South	7.8100	46.7521	0.6300	0.7000	0.7700	111.5896	(78)
West	1.4300	19.6403	0.6300	0.7000	0.7700	8.5833	(80)
East	3.5000	26.4442	0.6300	0.7000	1.0000	36.7350	(82)
West	1.0200	26.4442	0.6300	0.7000	1.0000	10.7056	(82)

Solar gains	186.3643	332.9367	493.1946	668.5143	797.0819	811.4583	774.0320	675.7638	553.9220	378.4558	226.1268	157.5634	(83)
Total gains	604.5515	749.6677	895.2605	1046.2955	1148.9389	1139.3485	1087.0010	992.9094	884.1130	733.0801	608.8788	562.6291	(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	51.2084	51.3167	51.4232	51.9296	52.0255	52.4764	52.4764	52.5608	52.3018	52.0255	51.8319	51.6311	
alpha	4.4139	4.4211	4.4282	4.4620	4.4684	4.4984	4.4984	4.5041	4.4868	4.4684	4.4555	4.4421	
util living area	0.9988	0.9967	0.9900	0.9657	0.8954	0.7518	0.5904	0.6570	0.8835	0.9835	0.9974	0.9991	(86)
MIT	19.4223	19.6115	19.9196	20.3233	20.6797	20.9027	20.9747	20.9598	20.7805	20.3047	19.7858	19.3912	(87)
Th 2	19.7971	19.7994	19.8015	19.8117	19.8137	19.8226	19.8226	19.8242	19.8191	19.8137	19.8098	19.8057	(88)
util rest of house	0.9984	0.9955	0.9862	0.9515	0.8508	0.6524	0.4469	0.5130	0.8153	0.9743	0.9963	0.9988	(89)
MIT 2	18.3669	18.5573	18.8651	19.2677	19.5970	19.7780	19.8164	19.8130	19.6949	19.2569	18.7398	18.3424	(90)
Living area fraction									fLA = Living area / (4) =			0.2015	(91)
MIT	18.5795	18.7697	19.0776	19.4804	19.8152	20.0046	20.0498	20.0441	19.9136	19.4680	18.9505	18.5537	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5795	18.7697	19.0776	19.4804	19.8152	20.0046	20.0498	20.0441	19.9136	19.4680	18.9505	18.5537	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	603.1916	745.2052	880.0752	990.2570	977.6331	762.7788	517.6002	538.3275	726.7381	711.5297	605.9046	561.7088	(94)
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	2241.2654	2172.3537	1965.8913	1637.6024	1253.7287	827.7966	528.3867	557.2440	893.4142	1370.0380	1837.6419	2234.4704	(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	1218.7269	959.0438	807.8472	466.0886	205.4151	0.0000	0.0000	0.0000	0.0000	489.9302	886.8509	1244.5346	(98)
Space heating												6278.4373	(98)
Space heating per m2										(98) / (4) =		54.2460	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1439.7412	1133.4133	1162.1776	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8018	0.8756	0.8395	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1154.4284	992.3711	975.6634	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1384.6963	1324.3258	1226.0905	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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	165.7929	246.9743	186.3178	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												599.0849 (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	41.4482	61.7436	46.5794	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												149.7712 (107)
Space cooling per m2												1.2940 (108)
Energy for space heating												54.2460 (99)
Energy for space cooling												1.2940 (108)
Total												55.5401 (109)
Target Fabric Energy Efficiency (TFEE)												63.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3478 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.4000	4.4000	4.1000	4.1000	3.7000	3.7000	3.5000	3.8000	4.2000	4.0000	4.3000 (22)
Wind factor	1.1500	1.1000	1.1000	1.0250	1.0250	0.9250	0.9250	0.8750	0.9500	1.0500	1.0000	1.0750 (22a)
Adj infilt rate	0.4000	0.3826	0.3826	0.3565	0.3565	0.3217	0.3217	0.3044	0.3304	0.3652	0.3478	0.3739 (22b)
Effective ac	0.5800	0.5732	0.5732	0.5636	0.5636	0.5518	0.5518	0.5463	0.5546	0.5667	0.5605	0.5699 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	57.0433	56.3740	56.3740	55.4258	55.4258	54.2656	54.2656	53.7302	54.5445	55.7344	55.1246	56.0505 (38)
Heat transfer coeff	178.4937	177.8244	177.8244	176.8762	176.8762	175.7160	175.7160	175.1806	175.9949	177.1848	176.5750	177.5009 (39)
Average = Sum(39)m / 12 =												176.8136 (39)
HLP	1.5422	1.5364	1.5364	1.5282	1.5282	1.5182	1.5182	1.5136	1.5206	1.5309	1.5256	1.5336 (40)
HLP (average)												1.5277 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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)
Output from w/h	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1750.4822 (64)												
1750 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.3071	55.3407	45.0060	34.0725	25.4696	21.5025	23.2342	30.2007	40.5353	51.4689	60.0718	64.0389 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.2517	421.5815	410.6706	387.4427	358.1216	330.5638	312.1536	307.8238	318.7347	341.9626	371.2838	398.8415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167 (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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095 (71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527 (72)
Total internal gains	672.8819	667.8864	641.7427	600.9217	558.6668	521.0488	499.1975	508.4688	532.0766	573.1309	618.8375	653.8544 (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				9.0600	12.7650	0.6300	0.7000	0.7700	35.3445 (74)			
South				12.2600	54.2217	0.6300	0.7000	0.7700	203.1587 (78)			
West				2.2500	23.8018	0.6300	0.7000	0.7700	16.3668 (80)			
East				5.4900	32.4561	0.6300	0.7000	1.0000	70.7211 (82)			
West				1.6000	32.4561	0.6300	0.7000	1.0000	20.6109 (82)			
Solar gains	346.2021	541.4769	791.5325	1105.4066	1281.8883	1382.6897	1304.8695	1164.1963	951.5502	652.7694	403.6572	294.2724 (83)
Total gains	1019.0839	1209.3633	1433.2752	1706.3283	1840.5551	1903.7385	1804.0671	1672.6651	1483.6268	1225.9004	1022.4946	948.1269 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	47.3614	47.5396	47.5396	47.7945	47.7945	48.1101	48.1101	48.2571	48.0338	47.7112	47.8760	47.6263
alpha	4.1574	4.1693	4.1693	4.1863	4.1863	4.2073	4.2073	4.2171	4.2023	4.1807	4.1917	4.1751
util living area	0.9917	0.9824	0.9550	0.8709	0.7236	0.5008	0.3572	0.3930	0.6838	0.9202	0.9829	0.9936 (86)
MIT	19.6148	19.8290	20.1816	20.5993	20.8616	20.9776	20.9958	20.9939	20.9181	20.5425	20.0044	19.5747 (87)
Th 2	19.6560	19.6603	19.6603	19.6664	19.6664	19.6739	19.6739	19.6773	19.6721	19.6644	19.6683	19.6624 (88)
util rest of house	0.9886	0.9762	0.9388	0.8277	0.6428	0.3897	0.2308	0.2588	0.5712	0.8823	0.9755	0.9912 (89)
MIT 2	17.8802	18.1919	18.6916	19.2533	19.5571	19.6641	19.6732	19.6762	19.6235	19.1978	18.4540	17.8264 (90)
Living area fraction	18.2297	18.5218	18.9918	19.5245	19.8199	19.9287	19.9397	19.9417	19.8844	19.4688	18.7664	18.1786 (92)
MIT	18.0797	18.3718	18.8418	19.3745	19.6699	19.7787	19.7897	19.7917	19.7344	19.3188	18.6164	18.0286 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	1001.9318	1169.9619	1326.6355	1393.1676	1183.6010	759.1834	436.6174	452.6575	856.0424	1065.9518	988.5580	935.5288 (95)
Ext temp.	4.7000	5.3000	7.0000	9.5000	12.4000	15.4000	17.3000	17.2000	14.6000	11.1000	7.6000	4.7000 (96)
Heat loss rate W	2388.2010	2324.4785	2105.7670	1746.5575	1285.8763	769.4120	437.4721	454.0117	903.6234	1456.2404	1945.2168	2365.8455 (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	1031.3843	775.8351	579.6739	254.4408	76.0928	0.0000	0.0000	0.0000	0.0000	290.3747	688.7943	1064.1556 (98)
Space heating												4760.7515 (98)
RHI space heating demand												4761 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF HEAT DEMAND 09 Jan 2014

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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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3478 (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	0.4435	0.4348	0.4261	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087 (22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5518	0.5605	0.5699	0.5766	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	58.8468	58.4712	58.1031	56.3740	56.0505	54.5445	54.5445	54.2656	55.1246	56.0505	56.7049	57.3891 (38)
Heat transfer coeff	180.2972	179.9216	179.5535	177.8244	177.5009	175.9949	175.9949	175.7160	176.5750	177.5009	178.1554	178.8396 (39)
Average = Sum(39)m / 12 =												177.8229 (39)
HLP	1.5578	1.5545	1.5514	1.5364	1.5336	1.5206	1.5206	1.5182	1.5256	1.5336	1.5393	1.5452 (40)
HLP (average)												1.5364 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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)
Output from w/h	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (64)
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1750.4822 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.3071	55.3407	45.0060	34.0725	25.4696	21.5025	23.2342	30.2007	40.5353	51.4689	60.0718	64.0389 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.2517	421.5815	410.6706	387.4427	358.1216	330.5638	312.1536	307.8238	318.7347	341.9626	371.2838	398.8415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167 (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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095 (71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527 (72)
Total internal gains	672.8819	667.8864	641.7427	600.9217	558.6668	521.0488	499.1975	508.4688	532.0766	573.1309	618.8375	653.8544 (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			9.0600		10.6334		0.6300		0.7000		0.7700		29.4423 (74)
South			12.2600		46.7521		0.6300		0.7000		0.7700		175.1714 (78)
West			2.2500		19.6403		0.6300		0.7000		0.7700		13.5052 (80)
East			5.4900		26.4442		0.6300		0.7000		1.0000		57.6215 (82)
West			1.6000		26.4442		0.6300		0.7000		1.0000		16.7932 (82)
Solar gains	292.5335	522.5971	774.1279	1049.2886	1251.0695	1273.6284	1214.8880	1060.6605	869.4379	594.0410	354.9463	247.3262	(83)
Total gains	965.4154	1190.4835	1415.8707	1650.2102	1809.7364	1794.6772	1714.0855	1569.1293	1401.5145	1167.1719	973.7838	901.1807	(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	46.8876	46.9855	47.0818	47.5396	47.6263	48.0338	48.0338	48.1101	47.8760	47.6263	47.4513	47.2698
alpha	4.1258	4.1324	4.1388	4.1693	4.1751	4.2023	4.2023	4.2073	4.1917	4.1751	4.1634	4.1513
util living area	0.9938	0.9849	0.9617	0.8967	0.7680	0.5914	0.4428	0.4993	0.7471	0.9402	0.9874	0.9953 (86)
MIT	19.5073	19.7448	20.0954	20.5094	20.8094	20.9524	20.9888	20.9818	20.8747	20.4531	19.8945	19.4633 (87)
Th 2	19.6444	19.6468	19.6492	19.6603	19.6624	19.6721	19.6721	19.6739	19.6683	19.6624	19.6582	19.6538 (88)
util rest of house	0.9915	0.9796	0.9480	0.8612	0.6965	0.4837	0.3137	0.3632	0.6452	0.9112	0.9821	0.9935 (89)
MIT 2	17.7162	18.0612	18.5624	19.1338	19.4989	19.6458	19.6690	19.6681	19.5838	19.0792	18.2889	17.6586 (90)
Living area fraction	18.0771	18.4004	18.8713	19.4110	19.7630	19.9091	19.9349	19.9328	19.8439	19.3561	18.6124	18.0222 (92)
MIT	18.0771	18.4004	18.8713	19.4110	19.7630	19.9091	19.9349	19.9328	19.8439	19.3561	18.6124	18.0222 (92)
Temperature adjustment	17.9271	18.2504	18.7213	19.2610	19.6130	19.7591	19.7849	19.7828	19.6939	19.2061	18.4624	17.8722 (93)
adjusted MIT	17.9271	18.2504	18.7213	19.2610	19.6130	19.7591	19.7849	19.7828	19.6939	19.2061	18.4624	17.8722 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9870	0.9715	0.9353	0.8482	0.6936	0.4912	0.3250	0.3748	0.6474	0.8979	0.9748	0.9899 (94)
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	2456.9281	2402.0285	2194.3770	1842.4346	1404.5590	907.9727	560.5246	594.4134	987.7371	1527.5818	2024.2717	2445.1293 (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	1119.0049	836.9659	647.3291	318.7231	111.1404	0.0000	0.0000	0.0000	0.0000	356.7758	774.0441	1155.4540 (98)
Space heating												5319.4373 (98)
Space heating per m2												(98) / (4) = 45.9602 (99)

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8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5897.3806 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1119.0049	836.9659	647.3291	318.7231	111.1404	0.0000	0.0000	0.0000	0.0000	356.7758	774.0441	1155.4540	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	1240.5819	927.9001	717.6597	353.3515	123.2155	0.0000	0.0000	0.0000	0.0000	395.5386	858.1420	1280.9912	(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 requirement	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721	(64)
Efficiency of water heater (217)m	89.7890	89.7298	89.6025	89.2819	88.5705	87.3000	87.3000	87.3000	87.3000	89.3286	89.6886	87.3000	(216)
Fuel for water heating, kWh/month	199.1711	174.6966	181.4436	160.0512	155.7554	137.7896	129.1112	146.1391	147.2966	166.0347	178.8443	193.2651	(219)
Water heating fuel used												1969.5985	(219)
Annual totals kWh/year													
Space heating fuel - main system												5897.3806	(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)												440.1455	(232)
Total delivered energy for all uses												8382.1246	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5897.3806	3.4800	205.2288 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1969.5985	3.4800	68.5420 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	440.1455	13.1900	58.0552 (250)
Additional standing charges			120.0000 (251)
Total energy cost			461.7186 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2064 (257)
SAP value		83.1703
SAP rating (Section 12)		83 (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	5897.3806	0.2160	1273.8342 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1969.5985	0.2160	425.4333 (264)
Space and water heating			1699.2675 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	440.1455	0.5190	228.4355 (268)
Total kg/year			1966.6280 (272)
CO2 emissions per m2			16.9900 (273)
EI value			83.6053
EI rating			84 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9020 = 3.858$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9020 = 0.2395$, stars = 4
Water heating energy efficiency	$3.48 / 0.8875 = 3.921$, stars = 4
Water heating environmental impact	$0.216 / 0.8875 = 0.2434$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3478 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.4000	4.4000	4.1000	4.1000	3.7000	3.7000	3.5000	3.8000	4.2000	4.0000	4.3000 (22)
Wind factor	1.1500	1.1000	1.1000	1.0250	1.0250	0.9250	0.9250	0.8750	0.9500	1.0500	1.0000	1.0750 (22a)
Adj infilt rate	0.4000	0.3826	0.3826	0.3565	0.3565	0.3217	0.3217	0.3044	0.3304	0.3652	0.3478	0.3739 (22b)
Effective ac	0.5800	0.5732	0.5732	0.5636	0.5636	0.5518	0.5518	0.5463	0.5546	0.5667	0.5605	0.5699 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	57.0433	56.3740	56.3740	55.4258	55.4258	54.2656	54.2656	53.7302	54.5445	55.7344	55.1246	56.0505 (38)
Heat transfer coeff	178.4937	177.8244	177.8244	176.8762	176.8762	175.7160	175.7160	175.1806	175.9949	177.1848	176.5750	177.5009 (39)
Average = Sum(39)m / 12 =												176.8136 (39)
HLP	1.5422	1.5364	1.5364	1.5282	1.5282	1.5182	1.5182	1.5136	1.5206	1.5309	1.5256	1.5336 (40)
HLP (average)												1.5277 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
Energy content (annual)										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

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Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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)
Output from w/h	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (64)
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1750.4822 (64)												

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.3071	55.3407	45.0060	34.0725	25.4696	21.5025	23.2342	30.2007	40.5353	51.4689	60.0718	64.0389 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.2517	421.5815	410.6706	387.4427	358.1216	330.5638	312.1536	307.8238	318.7347	341.9626	371.2838	398.8415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167 (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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095 (71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527 (72)
Total internal gains	672.8819	667.8864	641.7427	600.9217	558.6668	521.0488	499.1975	508.4688	532.0766	573.1309	618.8375	653.8544 (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				9.0600	12.7650	0.6300	0.7000	0.7700	35.3445 (74)			
South				12.2600	54.2217	0.6300	0.7000	0.7700	203.1587 (78)			
West				2.2500	23.8018	0.6300	0.7000	0.7700	16.3668 (80)			
East				5.4900	32.4561	0.6300	0.7000	1.0000	70.7211 (82)			
West				1.6000	32.4561	0.6300	0.7000	1.0000	20.6109 (82)			
Solar gains	346.2021	541.4769	791.5325	1105.4066	1281.8883	1382.6897	1304.8695	1164.1963	951.5502	652.7694	403.6572	294.2724 (83)
Total gains	1019.0839	1209.3633	1433.2752	1706.3283	1840.5551	1903.7385	1804.0671	1672.6651	1483.6268	1225.9004	1022.4946	948.1269 (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	47.3614	47.5396	47.5396	47.7945	47.7945	48.1101	48.1101	48.2571	48.0338	47.7112	47.8760	47.6263
alpha	4.1574	4.1693	4.1693	4.1863	4.1863	4.2073	4.2073	4.2171	4.2023	4.1807	4.1917	4.1751
util living area	0.9917	0.9824	0.9550	0.8709	0.7236	0.5008	0.3572	0.3930	0.6838	0.9202	0.9829	0.9936 (86)
MIT	19.6148	19.8290	20.1816	20.5993	20.8616	20.9776	20.9958	20.9939	20.9181	20.5425	20.0044	19.5747 (87)
Th 2	19.6560	19.6603	19.6603	19.6664	19.6664	19.6739	19.6739	19.6773	19.6721	19.6644	19.6683	19.6624 (88)
util rest of house	0.9886	0.9762	0.9388	0.8277	0.6428	0.3897	0.2308	0.2588	0.5712	0.8823	0.9755	0.9912 (89)
MIT 2	17.8802	18.1919	18.6916	19.2533	19.5571	19.6641	19.6732	19.6762	19.6235	19.1978	18.4540	17.8264 (90)
Living area fraction									fLA = Living area / (4) =			0.2015 (91)
MIT	18.2297	18.5218	18.9918	19.5245	19.8199	19.9287	19.9397	19.9417	19.8844	19.4688	18.7664	18.1786 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0797	18.3718	18.8418	19.3745	19.6699	19.7787	19.7897	19.7917	19.7344	19.3188	18.6164	18.0286 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	1001.9318	1169.9619	1326.6355	1393.1676	1183.6010	759.1834	436.6174	452.6575	856.0424	1065.9518	988.5580	935.5288 (94)
Ext temp.	4.7000	5.3000	7.0000	9.5000	12.4000	15.4000	17.3000	17.2000	14.6000	11.1000	7.6000	4.7000 (96)
Heat loss rate W	2388.2010	2324.4785	2105.7670	1746.5575	1285.8763	769.4120	437.4721	454.0117	903.6234	1456.2404	1945.2168	2365.8455 (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	1031.3843	775.8351	579.6739	254.4408	76.0928	0.0000	0.0000	0.0000	0.0000	290.3747	688.7943	1064.1556 (98)
Space heating												4760.7515 (98)
Space heating per m2												(98) / (4) = 41.1332 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5277.9950 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1031.3843	775.8351	579.6739	254.4408	76.0928	0.0000	0.0000	0.0000	0.0000	290.3747	688.7943	1064.1556	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	1143.4415	860.1277	642.6539	282.0851	84.3601	0.0000	0.0000	0.0000	0.0000	321.9232	763.6301	1179.7734	(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 requirement	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721	(64)
Efficiency of water heater (217)m	89.7594	89.6992	89.5484	89.1351	88.3093	87.3000	87.3000	87.3000	87.3000	89.1982	89.6376	87.3000	(216)
Fuel for water heating, kWh/month	199.2368	174.7563	181.5531	160.3148	156.2161	137.7896	129.1112	146.1391	147.2966	166.2774	178.9461	193.3267	(219)
Water heating fuel used												1970.9638	(219)
Annual totals kWh/year													
Space heating fuel - main system												5277.9950	(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)												440.1455	(232)
Total delivered energy for all uses												7764.1043	(238)

10a. Fuel costs - using BEDF prices (412)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5277.9950	4.2000	221.6758 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1970.9638	4.2000	82.7805 (247)
Pumps and fans for heating	75.0000	15.5400	11.6550 (249)
Energy for lighting	440.1455	15.5400	68.3986 (250)
Additional standing charges			90.0000 (251)
Total energy cost			474.5099 (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	5277.9950	0.2160	1140.0469 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1970.9638	0.2160	425.7282 (264)
Space and water heating			1565.7751 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	440.1455	0.5190	228.4355 (268)
Total kg/year			1833.1356 (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	5277.9950	1.2200	6439.1539 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1970.9638	1.2200	2404.5759 (264)
Space and water heating			8843.7298 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	440.1455	3.0700	1351.2466 (268)
Primary energy kWh/year			10425.2264 (272)
Primary energy kWh/m2/year			90.0745 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:
Current environmental impact rating:

B 83
B 84

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(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	Recommended
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	+ 1.0	-£ 35	-193 kg (10.5%)
U Solar photovoltaic panels	+ 8.3	-£ 289	-966 kg (58.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£35	1.67 kg/m ²	B 84 B 85
Solar photovoltaic panels	£289	8.34 kg/m ²	A 92 A 93
Total Savings	£324	10.01 kg/m ²	

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 412 TEST (27 Apr 2017)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£80	£88	-£8
Mains gas	£394	£352	£43
Space heating	£323	£323	£0
Water heating	£83	£48	£35
Lighting	£68	£68	£0
Generated (PV)	-£0	-£289	£289
Total cost of fuels	£474	£151	£324
Total cost of uses	£474	£150	£324
Delivered energy	67 kWh/m ²	43 kWh/m ²	24 kWh/m ²
Carbon dioxide emissions	1.8 tonnes	0.7 tonnes	1.2 tonnes
CO2 emissions per m ²	16 kg/m ²	6 kg/m ²	10 kg/m ²
Primary energy	90 kWh/m ²	31 kWh/m ²	59 kWh/m ²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP ♦ CODE ♦ SBEM ♦ DESIGN

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3478 (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	0.4435	0.4348	0.4261	0.3826	0.3739	0.3304	0.3304	0.3217	0.3478	0.3739	0.3913	0.4087 (22b)
Effective ac	0.5983	0.5945	0.5908	0.5732	0.5699	0.5546	0.5546	0.5518	0.5605	0.5699	0.5766	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	58.8468	58.4712	58.1031	56.3740	56.0505	54.5445	54.5445	54.2656	55.1246	56.0505	56.7049	57.3891 (38)
Heat transfer coeff	180.2972	179.9216	179.5535	177.8244	177.5009	175.9949	175.9949	175.7160	176.5750	177.5009	178.1554	178.8396 (39)
Average = Sum(39)m / 12 =												177.8229 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.5578	1.5545	1.5514	1.5364	1.5336	1.5206	1.5206	1.5182	1.5256	1.5336	1.5393	1.5452 (40)
HLP (average)												1.5364 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy conte	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
Energy content (annual)										Total = Sum(45)m =		1601.3070 (45)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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												1.1326 (H8)
Utilisation factor												0.5864 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.7744 (H14)
Volume ratio Veff/V												0.7369 (H15)
Solar storage volume factor												0.9389 (H16)
Solar input	-25.4627	-42.4900	-72.3653	-96.9838	-119.8153	-117.7975	-116.2408	-101.5602	-79.5420	-54.3178	-30.2025	-878.0858 (H17)
Solar input (sum of months) = Sum (63)m =												-878.0858 (63)
Output from w/h	153.3710	114.2649	90.2127	45.9130	18.1381	2.4928	0.0000	26.0193	49.0480	93.9987	130.2004	152.2642 (64)
Total per year (kWh/year) = Sum (64)m =												875.9230 (64)
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
(66)m	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.3071	55.3407	45.0060	34.0725	25.4696	21.5025	23.2342	30.2007	40.5353	51.4689	60.0718	64.0389	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.2517	421.5815	410.6706	387.4427	358.1216	330.5638	312.1536	307.8238	318.7347	341.9626	371.2838	398.8415	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	(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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	(71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527	(72)
Total internal gains	672.8819	667.8864	641.7427	600.9217	558.6668	521.0488	499.1975	508.4688	532.0766	573.1309	618.8375	653.8544	(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					9.0600	10.6334	0.6300	0.7000	0.7700	29.4423 (74)		
South					12.2600	46.7521	0.6300	0.7000	0.7700	175.1714 (78)		
West					2.2500	19.6403	0.6300	0.7000	0.7700	13.5052 (80)		
East					5.4900	26.4442	0.6300	0.7000	1.0000	57.6215 (82)		
West					1.6000	26.4442	0.6300	0.7000	1.0000	16.7932 (82)		
Solar gains	292.5335	522.5971	774.1279	1049.2886	1251.0695	1273.6284	1214.8880	1060.6605	869.4379	594.0410	354.9463	247.3262 (83)
Total gains	965.4154	1190.4835	1415.8707	1650.2102	1809.7364	1794.6772	1714.0855	1569.1293	1401.5145	1167.1719	973.7838	901.1807 (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	46.8876	46.9855	47.0818	47.5396	47.6263	48.0338	48.0338	48.1101	47.8760	47.6263	47.4513	47.2698
alpha	4.1258	4.1324	4.1388	4.1693	4.1751	4.2023	4.2023	4.2073	4.1917	4.1751	4.1634	4.1513
util living area	0.9938	0.9849	0.9617	0.8967	0.7680	0.5914	0.4428	0.4993	0.7471	0.9402	0.9874	0.9953 (86)
MIT	19.5073	19.7448	20.0954	20.5094	20.8094	20.9524	20.9888	20.9818	20.8747	20.4531	19.8945	19.4633 (87)
Th 2	19.6444	19.6468	19.6492	19.6603	19.6624	19.6721	19.6721	19.6739	19.6683	19.6624	19.6582	19.6538 (88)
util rest of house	0.9915	0.9796	0.9480	0.8612	0.6965	0.4837	0.3137	0.3632	0.6452	0.9112	0.9821	0.9935 (89)
MIT 2	17.7162	18.0612	18.5624	19.1338	19.4989	19.6458	19.6690	19.6681	19.5838	19.0792	18.2889	17.6586 (90)
Living area fraction									fLA = Living area / (4) =			0.2015 (91)
MIT	18.0771	18.4004	18.8713	19.4110	19.7630	19.9091	19.9349	19.9328	19.8439	19.3561	18.6124	18.0222 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9271	18.2504	18.7213	19.2610	19.6130	19.7591	19.7849	19.7828	19.6939	19.2061	18.4624	17.8722 (93)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9870	0.9715	0.9353	0.8482	0.6936	0.4912	0.3250	0.3748	0.6474	0.8979	0.9748	0.9899	(94)
Useful gains	952.8893	1156.5435	1324.3110	1399.7637	1255.1768	881.6040	557.0734	588.1559	907.4011	1048.0444	949.2104	892.0996	(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	2456.9281	2402.0285	2194.3770	1842.4346	1404.5590	907.9727	560.5246	594.4134	987.7371	1527.5818	2024.2717	2445.1293	(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	1119.0049	836.9659	647.3291	318.7231	111.1404	0.0000	0.0000	0.0000	0.0000	356.7758	774.0441	1155.4540	(98)
Space heating												5319.4373	(98)
Space heating per m2												(98) / (4) =	45.9602 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5897.3806 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1119.0049	836.9659	647.3291	318.7231	111.1404	0.0000	0.0000	0.0000	0.0000	356.7758	774.0441	1155.4540	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	1240.5819	927.9001	717.6597	353.3515	123.2155	0.0000	0.0000	0.0000	0.0000	395.5386	858.1420	1280.9912	(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	153.3710	114.2649	90.2127	45.9130	18.1381	2.4928	0.0000	26.0193	49.0480	93.9987	130.2004	152.2642	(64)
Efficiency of water heater	(217)m	89.8403	89.8350	89.8243	89.7816	87.3000	87.3000	87.3000	87.3000	89.5795	89.7706	87.3000	(216)
Fuel for water heating, kWh/month	170.7152	127.1850	100.4204	51.1143	20.2025	2.8555	0.0000	29.8044	56.1832	104.9333	145.0368	169.4602	(219)
Water heating fuel used												977.9108	(219)
Annual totals kWh/year													
Space heating fuel - main system												5897.3806	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												440.1455	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =									-1727.2394			-1727.2394	(233)
Total delivered energy for all uses												5713.1975	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5897.3806	3.4800	205.2288	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	977.9108	3.4800	34.0313	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	440.1455	13.1900	58.0552	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			205.9800	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)			0.5382 (257)
SAP value			92.4920
SAP rating (Section 12)			92 (258)
SAP band			A

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5897.3806	0.2160	1273.8342	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	977.9108	0.2160	211.2287	(264)
Space and water heating			1485.0629	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	440.1455	0.5190	228.4355	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			881.9362	(272)
CO2 emissions per m2			7.6200	(273)
EI value			92.6478	
EI rating			93	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	57.8700 (1b)	x 2.4100 (2b)	= 139.4667 (1b) - (3b)
First floor	57.8700 (1c)	x 2.7400 (2c)	= 158.5638 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.7400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 298.0305 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1342 (8)
Pressure test					Yes
Measured/design q50					5.5000
Infiltration rate					0.4092 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3478 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.4000	4.4000	4.1000	4.1000	3.7000	3.7000	3.5000	3.8000	4.2000	4.0000	4.3000 (22)
Wind factor	1.1500	1.1000	1.1000	1.0250	1.0250	0.9250	0.9250	0.8750	0.9500	1.0500	1.0000	1.0750 (22a)
Adj infilt rate	0.4000	0.3826	0.3826	0.3565	0.3565	0.3217	0.3217	0.3044	0.3304	0.3652	0.3478	0.3739 (22b)
Effective ac	0.5800	0.5732	0.5732	0.5636	0.5636	0.5518	0.5518	0.5463	0.5546	0.5667	0.5605	0.5699 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Doors			9.4000	1.4000	13.1600		(26a)
Windows (Uw = 1.40)			23.5700	1.3258	31.2481		(27)
Roof lights (Uw = 1.40)			7.0900	1.3258	9.3996		(27a)
Heat Loss Floor 1			57.8700	0.1400	8.1018	110.0000	6365.7000 (28a)
Main walls	170.5100	32.9700	137.5400	0.1800	24.7572	150.0000	20631.0000 (29a)
Slope	78.5200	7.0900	71.4300	0.1300	9.2859	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m ²)			306.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		95.9526		(33)
Internal Wall 1			52.0000			9.0000	468.0000 (32c)
Internal Wall 2			98.3700			9.0000	885.3300 (32c)
Internal Floor 1			57.8700			18.0000	1041.6600 (32d)
Internal Ceiling 1			57.8700			18.0000	1041.6600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30433.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 262.9458 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4978 (36)
Total fabric heat loss (33) + (36) = 121.4504 (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	57.0433	56.3740	56.3740	55.4258	55.4258	54.2656	54.2656	53.7302	54.5445	55.7344	55.1246	56.0505 (38)
Heat transfer coeff	178.4937	177.8244	177.8244	176.8762	176.8762	175.7160	175.7160	175.1806	175.9949	177.1848	176.5750	177.5009 (39)
Average = Sum(39)m / 12 =												176.8136 (39)
HLP	1.5422	1.5364	1.5364	1.5282	1.5282	1.5182	1.5182	1.5136	1.5206	1.5309	1.5256	1.5336 (40)
HLP (average)												1.5277 (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												2.8452 (42)
Average daily hot water use (litres/day)												101.7744 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	111.9518	107.8808	103.8098	99.7389	95.6679	91.5969	91.5969	95.6679	99.7389	103.8098	107.8808	111.9518 (44)
Energy content (annual)	166.0213	145.2033	149.8368	130.6313	125.3439	108.1622	100.2282	115.0133	116.3870	135.6378	148.0592	160.7827 (45)
										Total = Sum(45)m =		1601.3070 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Distribution loss (46)m = 0.15 x (45)m	24.9032	21.7805	22.4755	19.5947	18.8016	16.2243	15.0342	17.2520	17.4580	20.3457	22.2089	24.1174 (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	12.8124	11.5516	12.7412	12.2655	12.6096	12.1281	12.4859	12.5661	12.2030	12.6787	12.3437	12.7894 (61)
Total heat required for water heating calculated for each month	178.8337	156.7549	162.5780	142.8968	137.9534	120.2904	112.7141	127.5794	128.5899	148.3165	160.4029	173.5721 (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												1162.7634 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1953.4426 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2199 (H8)
Utilisation factor												0.5595 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												101.7744 (H14)
Volume ratio Veff/V												0.7369 (H15)
Solar storage volume factor												0.9389 (H16)
Solar input												-902.2729 (H17)
Solar input	-29.0018	-42.3298	-70.9550	-97.6236	-117.0307	-121.8192	-118.9635	-106.3942	-83.3600	-57.3421	-33.0501	-24.4030 (63)
Solar input (sum of months) = Sum (63)m =												-902.2729 (63)
Output from w/h	149.8320	114.4251	91.6230	45.2732	20.9227	0.0000	0.0000	21.1852	45.2299	90.9745	127.3528	149.1691 (64)
Total per year (kWh/year) = Sum (64)m =												855.9875 (64)
Heat gains from water heating, kWh/month	58.4052	51.1680	53.0060	46.5013	44.8292	38.9960	36.4473	41.3835	41.7494	48.2692	52.3156	56.6576 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
(66)m	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	170.7142	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	62.3071	55.3407	45.0060	34.0725	25.4696	21.5025	23.2342	30.2007	40.5353	51.4689	60.0718	64.0389	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	417.2517	421.5815	410.6706	387.4427	358.1216	330.5638	312.1536	307.8238	318.7347	341.9626	371.2838	398.8415	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	54.9167	(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)	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	-113.8095	(71)
Water heating gains (Table 5)	78.5016	76.1428	71.2447	64.5851	60.2543	54.1611	48.9884	55.6229	57.9853	64.8780	72.6606	76.1527	(72)
Total internal gains	672.8819	667.8864	641.7427	600.9217	558.6668	521.0488	499.1975	508.4688	532.0766	573.1309	618.8375	653.8544	(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			9.0600		12.7650		0.6300		0.7000		0.7700		35.3445 (74)
South			12.2600		54.2217		0.6300		0.7000		0.7700		203.1587 (78)
West			2.2500		23.8018		0.6300		0.7000		0.7700		16.3668 (80)
East			5.4900		32.4561		0.6300		0.7000		1.0000		70.7211 (82)
West			1.6000		32.4561		0.6300		0.7000		1.0000		20.6109 (82)
Solar gains	346.2021	541.4769	791.5325	1105.4066	1281.8883	1382.6897	1304.8695	1164.1963	951.5502	652.7694	403.6572	294.2724	(83)
Total gains	1019.0839	1209.3633	1433.2752	1706.3283	1840.5551	1903.7385	1804.0671	1672.6651	1483.6268	1225.9004	1022.4946	948.1269	(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	47.3614	47.5396	47.5396	47.7945	47.7945	48.1101	48.1101	48.2571	48.0338	47.7112	47.8760	47.6263
alpha	4.1574	4.1693	4.1693	4.1863	4.1863	4.2073	4.2073	4.2171	4.2023	4.1807	4.1917	4.1751
util living area	0.9917	0.9824	0.9550	0.8709	0.7236	0.5008	0.3572	0.3930	0.6838	0.9202	0.9829	0.9936 (86)
MIT	19.6148	19.8290	20.1816	20.5993	20.8616	20.9776	20.9958	20.9939	20.9181	20.5425	20.0044	19.5747 (87)
Th 2	19.6560	19.6603	19.6603	19.6664	19.6664	19.6739	19.6739	19.6773	19.6721	19.6644	19.6683	19.6624 (88)
util rest of house	0.9886	0.9762	0.9388	0.8277	0.6428	0.3897	0.2308	0.2588	0.5712	0.8823	0.9755	0.9912 (89)
MIT 2	17.8802	18.1919	18.6916	19.2533	19.5571	19.6641	19.6732	19.6762	19.6235	19.1978	18.4540	17.8264 (90)
Living area fraction									fLA = Living area / (4) =			0.2015 (91)
MIT	18.2297	18.5218	18.9918	19.5245	19.8199	19.9287	19.9397	19.9417	19.8844	19.4688	18.7664	18.1786 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0797	18.3718	18.8418	19.3745	19.6699	19.7787	19.7897	19.7917	19.7344	19.3188	18.6164	18.0286 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9832	0.9674	0.9256	0.8165	0.6431	0.3988	0.2420	0.2706	0.5770	0.8695	0.9668	0.9867	(94)
Useful gains	1001.9318	1169.9619	1326.6355	1393.1676	1183.6010	759.1834	436.6174	452.6575	856.0424	1065.9518	988.5580	935.5288	(95)
Ext temp.	4.7000	5.3000	7.0000	9.5000	12.4000	15.4000	17.3000	17.2000	14.6000	11.1000	7.6000	4.7000	(96)
Heat loss rate W	2388.2010	2324.4785	2105.7670	1746.5575	1285.8763	769.4120	437.4721	454.0117	903.6234	1456.2404	1945.2168	2365.8455	(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	1031.3843	775.8351	579.6739	254.4408	76.0928	0.0000	0.0000	0.0000	0.0000	290.3747	688.7943	1064.1556	(98)
Space heating												4760.7515	(98)
Space heating per m2											(98) / (4) =	41.1332	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5277.9950 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1031.3843	775.8351	579.6739	254.4408	76.0928	0.0000	0.0000	0.0000	0.0000	290.3747	688.7943	1064.1556	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	1143.4415	860.1277	642.6539	282.0851	84.3601	0.0000	0.0000	0.0000	0.0000	321.9232	763.6301	1179.7734	(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	149.8320	114.4251	91.6230	45.2732	20.9227	0.0000	0.0000	21.1852	45.2299	90.9745	127.3528	149.1691	(64)
Efficiency of water heater	89.8215	89.8165	89.7929	89.7496	89.5584	87.3000	87.3000	87.3000	87.3000	89.4908	89.7349	87.3000	(216)
(217)m	89.8215	89.8165	89.7929	89.7496	89.5584	87.3000	87.3000	87.3000	87.3000	89.4908	89.7349	89.8331	(217)
Fuel for water heating, kWh/month	166.8108	127.3987	102.0382	50.4438	23.3621	0.0000	0.0000	24.2671	51.8098	101.6579	141.9212	166.0514	(219)
Water heating fuel used												955.7609	(219)
Annual totals kWh/year													
Space heating fuel - main system												5277.9950	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													440.1455 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1163 * 0.80) =									-1860.4215			-1860.4215	(233)
Total delivered energy for all uses												4938.4800	(238)

10a. Fuel costs - using BEDF prices (412)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5277.9950	4.2000	221.6758	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	955.7609	4.2000	40.1420	(247)
Pumps and fans for heating	75.0000	15.5400	11.6550	(249)
Pump for solar water heating	50.0000	15.5400	7.7700	(249)
Energy for lighting	440.1455	15.5400	68.3986	(250)
Additional standing charges			90.0000	(251)
Energy saving/generation technologies				
PV Unit	-1860.4215	15.5400	-289.1095	(252)
Total energy cost			150.5319	(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	5277.9950	0.2160	1140.0469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	955.7609	0.2160	206.4444	(264)
Space and water heating			1346.4913	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	440.1455	0.5190	228.4355	(268)
Energy saving/generation technologies				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

PV Unit	-1860.4215	0.5190	-965.5587 (269)
Total kg/year			674.2430 (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	5277.9950	1.2200	6439.1539 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	955.7609	1.2200	1166.0284 (264)
Space and water heating			7605.1823 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	440.1455	3.0700	1351.2466 (268)
Energy saving/generation technologies			
PV Unit	-1860.4215	3.0700	-5711.4940 (269)
Primary energy kWh/year			3628.6849 (272)
Primary energy kWh/m2/year			31.3520 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	262.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	786.80 (P1)
Transmission heat loss coefficient	121.45 (37)
Summer heat loss coefficient	908.25 (P2)

Overhangs Orientation	Ratio	Z_overhangs	Overhang type
North	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	1.00	1.000	1.000 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)
West	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	9.0600	81.1852	0.6300	0.7000	0.9000	262.7414
South	12.2600	112.2060	0.6300	0.7000	0.9000	491.3943
West	2.2500	117.5071	0.6300	0.7000	0.9000	94.4431
East	5.4900	201.3938	0.6300	0.7000	1.0000	438.8333
West	1.6000	201.3938	0.6300	0.7000	1.0000	127.8931

total: 1415.3053

	Jun	Jul	Aug	
Solar gains	1500	1415	1265	(P3)
Internal gains	518	496	505	
Total summer gains	2018	1912	1770	(P5)

	2.22	2.10	1.95	
Summer gain/loss ratio	2.22	2.10	1.95	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 262.9)	0.16	0.16	0.16	
Threshold temperature	18.38	20.16	19.91	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			

THERMAL BRIDGING

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Calculation Type: New Build (As Designed)

Property Reference	005151	Issued on Date	22/05/2017
Survey Reference	001	Prop Type Ref	
Property	Adj., 20, Venetia Close, Emmer Green, READING, RG4 8UG		
SAP Rating	83 B	DER	18.55
Environmental	84 B	TER	18.70
CO ₂ Emissions (t/year)	1.83	% DER<TER	0.81
General Requirements Compliance	Pass	DFEE	60.13
		TFEE	63.87
		% DFEE<TFEE	5.86
Surveyor	Matthew Carter, Tel: 01754 761035	Surveyor ID	7869-0001
Client			

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	25.60	7.68	
External wall	E3 Sill	Table K1 - Approved	0.040	20.80	0.83	
External wall	E4 Jamb	Table K1 - Approved	0.050	49.36	2.47	
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	37.10	5.94	
External wall	E6 Intermediate floor within a dwelling	Table K1 - Approved	0.070	37.10	2.60	
External wall	E11 Eaves (insulation at rafter level)	Table K1 - Approved	0.040	34.36	1.37	
External wall	E13 Gable (insulation at rafter level)	Table K1 - Approved	0.040	18.28	0.73	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	25.14	2.26	
External wall	E17 Corner (inverted – internal area greater than external area)	Table K1 - Approved	-0.090	8.38	-0.75	
External roof	R1 Head of roof window	Table K1 - Default	0.080	2.56	0.20	
External roof	R2 Sill of roof window	Table K1 - Default	0.060	2.56	0.15	
External roof	R3 Jamb of roof window	Table K1 - Default	0.080	5.61	0.45	
External roof	R4 Ridge (vaulted ceiling)	Table K1 - Default	0.080	17.00	1.36	
External roof	R5 Ridge (inverted)	Table K1 - Default	0.040	5.09	0.20	

Total: **25.50** W/mK:
Y-Value: **0.083** W/m²K:

U-VALUE CALCULATOR REPORT

Property Reference	005151	Issued on Date	22/05/2017
Survey Reference	001	Prop Type Ref	
Project	Adj., 20, Venetia Close, Emmer Green, READING, RG4 8UG		
Calculation Type	New Build (As Designed)		

SAP Rating	83 B	DER	18.55	TER	18.70
Environmental	84 B	% DER<TER	0.81		
CO ₂ Emissions (t/year)	1.83	DFEE	60.13	TFEE	63.87
General Requirements Compliance	Pass	% DFEE<TFEE	5.86		

Surveyor	Matthew Carter, Tel: 01754 761035	Surveyor ID	7869-0001
Client			

Building Elements

Roof 000002 - pitched roof - insulated slope, sloping

Roof Type: Pitched Roof, insulated sloping ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.1000	
Layer 1	Tiles, clay				
	Main construction	15	1.0000	0.0000	100.00
Layer 2	Air layer ventilated				
	Main construction	25	0.2500	0.0000	100.00
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 3	Sarking Felt				
	Main construction	1	0.2300	0.0000	100.00
Layer 4	Air layer ventilated				
	Main construction	50	0.5000	0.0000	100.00
	Corrections - Cavity Ventilated, Emissivity: Normal				
Layer 5	Celotex XR4000				
	Main construction	150	0.0220	6.8182	91.67
	Main construction	150	0.1300	1.1538	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 6	Celotex GA4000				
	Main construction	60	0.0220	2.7273	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1000	

Total resistance: Upper limit = 8.802 m² K/W Lower limit = 7.826 m² K/W Average = 8.314 m² K/W
Total correction = 0.0045 m² K/W U-value (unrounded) = 0.13 W/m² K

Unheated space: None

Total thickness: 314 mm

U-value: 0.13 W/m² K

Kappa: n/a

U-VALUE CALCULATOR REPORT

Property Reference	005151	Issued on Date	22/05/2017
Survey Reference	001	Prop Type Ref	
Project	Adj., 20, Venetia Close, Emmer Green, READING, RG4 8UG		
Calculation Type	New Build (As Designed)		
SAP Rating	83 B	DER	18.55
Environmental	84 B	TER	18.70
CO ₂ Emissions (t/year)	1.83	% DER<TER	0.81
General Requirements Compliance	Pass	DFEE	60.13
		TFEE	63.87
		% DFEE<TFEE	5.86
Surveyor	Matthew Carter, Tel: 01754 761035	Surveyor ID	7869-0001
Client			

Building Elements

Wall 000001 - Masonry wall full cavity fill-slabs

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	Brick, outer leaf				
	Main construction	100	0.7700	0.1299	100.00
Layer 2	CavityTherm Full Fill				
	Main construction	100	0.0210	4.7619	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	Celcon Standard - Normal - Trad joint 10mm				
	Main construction	100	0.1500	0.6667	93.18
	Main construction	100	0.8803	0.1136	6.82
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 wallboard)				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1300	

Total resistance: Upper limit = 5.917 m² K/W Lower limit = 5.792 m² K/W Average = 5.854 m² K/W
Total correction = 0.0066 m² K/W U-value (unrounded) = 0.18 W/m² K

Unheated space: None

Total thickness: 328 mm

U-value: 0.18 W/m² K

Kappa: n/a

PREDICTED ENERGY ASSESSMENT

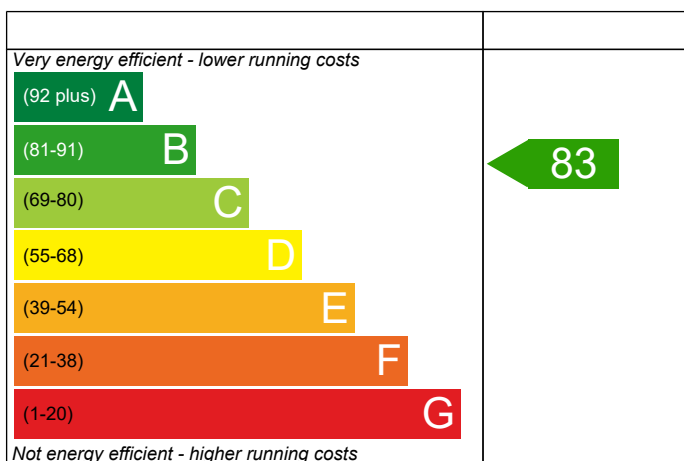
Adj., 20, Venetia Close,
Emmer Green,
READING,
RG4 8UG

Dwelling type: House, Detached
Date of assessment: 22/05/2017
Produced by: Energy Calculations Limited
Total floor area: 115.74 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 (CO₂) emissions.

Energy Efficiency Rating

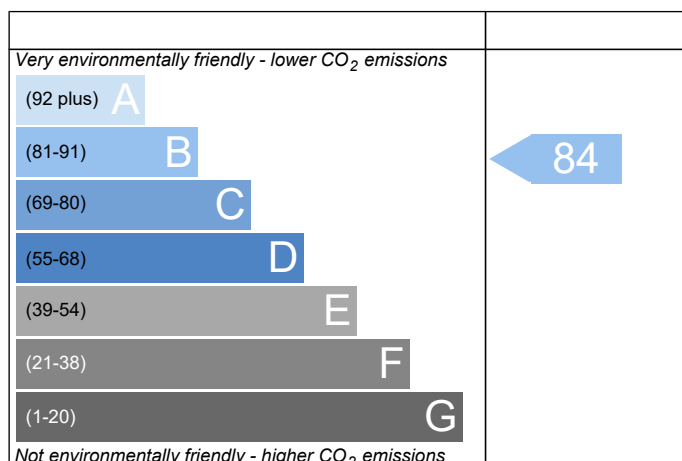


England

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 (CO₂) 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 (CO₂) emissions. The higher the rating the less impact it has on the environment.