



SAP Report Submission for Building Regulations Compliance

Client: Highwood Construction Ltd

Project: 1 Harding Road
EASTLEIGH, SO50 9RB

Contact: Scott Spearing | BEAT Solutions
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Report Issue Date: 10/02/2023

EXCELLENCE
IN ENERGY
ASSESSMENT

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Built)

Property Reference	SAP-0796 (3B4A) - Plot 215				Issued on Date	10/02/2023
Assessment Reference	AB	Prop Type Ref	Type 3.1+			
Property	1 Harding Road, EASTLEIGH, SO50 9RB					
SAP Rating	87 B	DER	14.12	TER	17.52	
Environmental	87 B	% DER<TER	19.41			
CO ₂ Emissions (t/year)	1.24	DFEE	49.74	TFEE	59.48	
General Requirements Compliance	Pass	% DFEE<TFEE	16.37			
Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk				Assessor ID	p775-0001
Client	Highwood Construction Ltd, HIGHWOOD					

SUMMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.52	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.12	kgCO ₂ /m ²	Pass
	-3.40 (-19.4%)	kgCO ₂ /m ²	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	59.48	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DFEE)	49.74	kWh/m ² /yr	
	-9.8 (-16.5%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	Pass
Floor	0.17 (max. 0.25)	0.17 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (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	4.98 (measured in this dwelling)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Ideal Logic Heat 15 Efficiency: 89.3% SEDBUK2009 Minimum: 88.0%	Pass
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BASIC COMPLIANCE REPORT

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Secondary heating system

None

5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.27 kWh/day
Permitted by DBSCG 2.10

Pass

Primary pipework insulated

Yes

Pass

6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)

Not significant

Pass

Based on:

Overshading

Average

Windows facing North East

0.96 m², No overhang

Windows facing East

0.87 m², No overhang

Windows facing South East

5.88 m², No overhang

Windows facing South

1.73 m², No overhang

Windows facing South West

2.93 m², No overhang

Windows facing West

0.87 m², No overhang

Windows facing North West

8.11 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

4.98 (measured in this dwelling)

Maximum

10.0

Pass

10 Key features

Roof U-value

0.10

W/m²K

Photovoltaic array

1.60

kW

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

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

Orientation	South East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2023
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	32.45 m	59.55 m ²	2.40 m
1st Storey:	31.40 m	57.14 m ²	2.66 m

7.0 Living Area	21.88	m ²
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8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	82.77	kJ/m²K

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)
External Wall	Timber Frame	Timber framed wall (one layer of plasterboard)	0.20	9.00	161.40	137.89

9.2 Internal Walls

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Wall - GF	Plasterboard on timber frame	9.00	50.88
Internal Wall - FF	Plasterboard on timber frame	9.00	99.98

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)
External Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	59.55	59.55

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m ² K)	Area (m ²)
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	57.14

11.0 Heat Loss Floors

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Heat Loss Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.17	75.00	59.55

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	57.14

12.0 Opening Types

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

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] External Wall	South East							2.16	
Front Elevation	Window	[1] External Wall	South East	None	0.00					5.88	
Bay 1	Window	[1] External Wall	West	None	0.00					0.87	
Rear Elevation	Window	[1] External Wall	North West	None	0.00					8.11	
Side Elevation	Window	[1] External Wall	South West	None	0.00					2.93	
Bay 2	Window	[1] External Wall	South	None	0.00					1.73	
Bay 3	Window	[1] External Wall	East	None	0.00					0.87	
Side Elevation	Window	[1] External Wall	North East	None	0.00					0.96	

14.0 Conservatory

None

15.0 Draught Proofing

100 %

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Independently assessed	E2 Other lintels (including other steel lintels)	16.82	0.088	Yes
Independently assessed	E3 Sill	15.80	0.030	Yes
Independently assessed	E4 Jamb	46.84	0.037	Yes
Independently assessed	E5 Ground floor (normal)	32.45	0.115	Yes
Independently assessed	E6 Intermediate floor within a dwelling	31.40	0.065	Yes
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	11.17	0.060	No
Independently assessed	E12 Gable (insulation at ceiling level)	20.23	0.069	No
Table K1 - Default	E15 Flat roof with parapet	6.12	0.560	No
Independently assessed	E16 Corner (normal)	30.10	0.055	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	15.80	-0.090	No

Y-value	0.054	W/m²K
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18.0 Pressure Testing

Designed AP ₅₀	Yes	
Designed AP ₅₀	6.00	m³/(h.m²) @ 50 Pa
Property Tested ?	Yes	
As Built AP ₅₀	4.98	m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

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

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

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	20	
Total number of L.E.L. fittings	20	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted

23.0 Electricity Tariff

24.0 Main Heating 1

Database	Database	
Description	Gas Boiler	
Percentage of Heat	100	%
Database Ref. No.	16400	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.3	
In Summer	79.6	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2

Community Heating

28.0 Water Heating

Water Heating	HWP From main heating 1
Flue Gas Heat Recovery System	Main Heating 1
Waste Water Heat Recovery	No
Instantaneous System 1	No

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Waste Water Heat Recovery Instantaneous System 2	No			
Waste Water Heat Recovery Storage System	No			
Solar Panel	No			
Water use <= 125 litres/person/day	Yes			
SAP Code	901			
29.0 Hot Water Cylinder	Hot Water Cylinder			
Cylinder Stat	Yes			
Cylinder In Heated Space	Yes			
Independent Time Control	Yes			
Insulation Type	Measured Loss			
Cylinder Volume	180.00	L		
Loss	1.27	kWh/day		
Pipes insulation	Fully insulated primary pipework			
31.0 Thermal Store	None			
32.0 Photovoltaic Unit	One Dwelling			
PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.60	North West	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£46	B 89	

U-VALUE CALCULATOR REPORT

Property Reference	SAP-0796 (3B4A) - Plot 215	Issued on Date	10/02/2023
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CO ₂ Emissions (t/year)	1.24	DFEE	49.74	TFEE	59.48
General Requirements Compliance	Pass	% DFEE<TFEE	16.37		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	Assessor ID	A808-0004
Client	Highwood Construction Ltd, HIGHWOOD		

Building Elements

Roof Pitched Roof - 400mm Quilt

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	Mineral wool				
	Main construction	300	0.0400	7.5000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	Mineral wool				
	Main construction	100	0.0400	2.5000	92.17
	Main construction	100	0.1300	0.7692	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 4	Plaster, standard				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance:	Upper limit = 10.046 m ² K/W	Lower limit = 9.832 m ² K/W	Average = 9.939 m ² K/W
	Total correction = 0.0005 m ² K/W	U-value (unrounded) = 0.1 W/m ² K	

Unheated space: None

Total thickness: 416 mm

U-value: 0.10 W/m² K

Kappa: n/a

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Client	Highwood Construction Ltd, HIGHWOOD
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Building Elements

Wall 000001 - Stoneham - TF

Wall Type: Timber framed Wall with I-beams

U-VALUE CALCULATOR REPORT

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.2900	
Layer 1	Brick, outer leaf				
	Main construction	100	0.7700	0.0000	82.81
	Main construction	100	0.9407	0.0000	17.19
Layer 2	Standard cavity				
	Main construction	50	0.0000	0.0000	100.00
	Corrections - Cavity Ventilated, Emissivity: Low Emissivity (BR443)				
Layer 3	Breather membrane				
	Main construction	1	0.0000	0.0000	100.00
Layer 4	Orientated Strand Board				
	Main construction	9	0.1300	0.0692	100.00
Layer 5	Timber Frame Void				
	Main construction	20	0.1143	0.1750	92.17
	Main construction	20	0.1300	0.1538	7.83
	Corrections - Cavity Unventilated, Emissivity: Low Emissivity (BR443)				
Layer 6	Celotex GA4000				
	Main construction	100	0.0220	4.5455	92.17
	Main construction	100	0.1300	0.7692	7.83
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	Timber Frame Void				
	Main construction	20	0.1143	0.1750	92.17
	Main construction	20	0.1300	0.1538	7.83
	Corrections - Cavity Unventilated, Emissivity: Low Emissivity (BR443)				
Layer 8	Polythene, 500 gauge				
	Main construction	1	0.0000	0.0000	100.00
Layer 9	Service Void				
	Main construction	25	0.0321	0.7800	89.63
	Main construction	25	0.1300	0.1923	10.37
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 10	Plasterboard, standard				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 11	Plaster, standard				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit** = 5.477 m² K/W **Lower limit** = 4.778 m² K/W **Average** = 5.128 m² K/W
Total correction = 0.0041 m² K/W **U-value (unrounded)** = 0.2 W/m² K

Unheated space: None

Total thickness: 342 mm

U-value: 0.20 W/m² K

Kappa: n/a

U-VALUE CALCULATOR REPORT

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Building Elements

Floor Ground Floor - Stoneham - Ground Floor

Floor Type: Suspended Floor

Area = 59.55 m², Perimeter = 32.45 m, Wall thickness = 275.00 mm, Soil: Unknown

Depth of underfloor space below ground: 0.200 m Floor wind shielding: Average (suburban)

Floor height above ground: h = 0.200 m

U-value of walls above ground: U_w = 1.500 m

Ventilation openings per perimeter length: e = 0.0015 %

Mean wind speed: v = 5.000 m/s

Resistance on solum: R_g = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)
Ext surface				0.1700	
Layer 1	Blockwork, dense				
	Main construction	100	1.5900	0.0629	82.95
	Main construction	100	2.2000	0.0455	17.05
Layer 2	Jablite Jabfloor (HP)				
	Main construction	150	0.0320	4.6875	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	Screed				
	Main construction	75	1.1500	0.0652	100.00
Int surface				0.1700	

Total resistance: Upper limit = 5.153 m² K/W Lower limit = 5.152 m² K/W Average = 5.152 m² K/W

Total correction = 0.0083 m² K/W

U-value (unrounded) = 0.17 W/m² K

Unheated space: None

Total thickness: 325 mm

U-value: 0.17 W/m² K

Kappa: n/a

FULL SAP CALCULATION PRINTOUT

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FULL SAP CALCULATION PRINTOUT

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

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

DWELLING AS BUILT

Detached House, total floor area 117 m²

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

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.52 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 14.12 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)59.5 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)49.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	0.17 (max. 0.25)	0.17 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (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:	4.98 (measured in this dwelling)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Ideal Logic Heat 15

Efficiency: 89.3% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.27 kWh/day

Permitted by DBSCG 2.10 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: Cylinderstat OK

Independent timer for DHW OK

Boiler interlock Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Southern England): Not significant OK

Based on:

Overshading: Average

Windows facing North East: 0.96 m², No overhang

Windows facing East: 0.87 m², No overhang

Windows facing South East: 5.88 m², No overhang

Windows facing South: 1.73 m², No overhang

Windows facing South West: 2.93 m², No overhang

Windows facing West: 0.87 m², No overhang

Windows facing North West: 8.11 m², No overhang

Air change rate: 8.00 ach

Blinds/curtains: None

10 Key features

Roof U-value 0.10 W/m²K

Photovoltaic array 1.60 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (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) = 0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3846 (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	0.4904	0.4808	0.4712	0.4231	0.4135	0.3654	0.3654	0.3558	0.3846	0.4135	0.4327	0.4519 (22b)
Effective ac	0.6202	0.6156	0.6110	0.5895	0.5855	0.5668	0.5668	0.5633	0.5740	0.5855	0.5936	0.6021 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss							(33) + (36) = 90.1722 (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	60.3634	59.9090	59.4635	57.3713	56.9799	55.1576	55.1576	54.8202	55.8595	56.9799	57.7718	58.5996 (38)
Heat transfer coeff	150.5356	150.0811	149.6357	147.5435	147.1521	145.3298	145.3298	144.9924	146.0317	147.1521	147.9439	148.7718 (39)
Average = Sum(39)m / 12 =												147.5416 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2900	1.2862	1.2823	1.2644	1.2611	1.2454	1.2454	1.2425	1.2515	1.2611	1.2678	1.2749 (40)
HLP (average)												1.2644 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)												Total = Sum(45)m = 1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

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Water storage loss:	24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6858 (55)
Total storage loss												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(56)
If cylinder contains dedicated solar storage												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(64)
Heat gains from water heating, kWh/month												
90.8756	80.4997	85.4888	77.9476	77.3367	70.4691	68.9773	73.8983	73.2065	80.7629	83.7482	89.1320	(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	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
25.5066	22.6547	18.4241	13.9482	10.4264	8.8024	9.5113	12.3632	16.5939	21.0697	24.5915	26.2155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
280.8392	283.7534	276.4096	260.7756	241.0405	222.4922	210.1009	207.1866	214.5304	230.1644	249.8996	268.4478	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	(71)
Water heating gains (Table 5)												
122.1446	119.7913	114.9043	108.2605	103.9472	97.8737	92.7114	99.3257	101.6758	108.5522	116.3170	119.8011	(72)
Total internal gains												
497.2339	494.9429	478.4815	451.7278	424.1576	397.9119	381.0671	387.6190	401.5435	428.5299	459.5515	483.2079	(73)

6. Solar gains

[Jan]				Area	Solar flux		g	FF	Access		Gains	
				m2	Table 6a		Specific data	Specific data	factor	W		
					W/m2		or Table 6b	or Table 6c	Table 6d			
Northeast				0.9600		11.2829	0.6300	0.7000	0.7700		3.3103	(75)
East				0.8700		19.6403	0.6300	0.7000	0.7700		5.2220	(76)
Southeast				5.8800		36.7938	0.6300	0.7000	0.7700		66.1187	(77)
South				1.7300		46.7521	0.6300	0.7000	0.7700		24.7183	(78)
Southwest				2.9300		36.7938	0.6300	0.7000	0.7700		32.9469	(79)
West				0.8700		19.6403	0.6300	0.7000	0.7700		5.2220	(80)
Northwest				8.1100		11.2829	0.6300	0.7000	0.7700		27.9650	(81)

Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680 (83)
Total gains	662.7371	788.2629	909.2782	1033.5262	1118.6634	1105.9769	1056.0040	975.8048	884.3048	760.7358	659.8838	623.4759 (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	17.8215	17.8755	17.9287	18.1829	18.2313	18.4599	18.4599	18.5029	18.3712	18.2313	18.1337	18.0328
alpha	2.1881	2.1917	2.1952	2.2122	2.2154	2.2307	2.2307	2.2335	2.2247	2.2154	2.2089	2.2022
util living area	0.9596	0.9405	0.9082	0.8481	0.7551	0.6289	0.5083	0.5529	0.7336	0.8805	0.9434	0.9643 (86)
MIT	17.9569	18.2820	18.8162	19.5135	20.1421	20.6136	20.8308	20.7898	20.4101	19.5905	18.6574	17.9071 (87)
Th 2	19.8486	19.8517	19.8547	19.8688	19.8715	19.8838	19.8838	19.8861	19.8791	19.8715	19.8661	19.8605 (88)
util rest of house	0.9538	0.9321	0.8947	0.8244	0.7135	0.5585	0.4063	0.4528	0.6736	0.8568	0.9340	0.9592 (89)
MIT 2	17.0802	17.4026	17.9295	18.6153	19.2093	19.6363	19.8045	19.7812	19.4710	18.7045	17.7875	17.0387 (90)
Living area fraction	17.2446	17.5675	18.0957	18.7837	19.3842	19.8195	19.9969	19.9703	19.6471	18.8707	17.9506	17.2015 (91)
MIT	17.2446	17.5675	18.0957	18.7837	19.3842	19.8195	19.9969	19.9703	19.6471	18.8707	17.9506	17.2015 (92)
Temperature adjustment												0.0000
adjusted MIT	17.2446	17.5675	18.0957	18.7837	19.3842	19.8195	19.9969	19.9703	19.6471	18.8707	17.9506	17.2015 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9356	0.9095	0.8680	0.7967	0.6927	0.5539	0.4176	0.4611	0.6591	0.8301	0.9123	0.9425 (94)
Useful gains	620.0679	716.9634	789.2966	823.4529	774.8900	612.6429	440.9403	449.9579	582.8889	631.5010	602.0061	587.6039 (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												
1948.6251	1901.1565	1735.1335	1458.2756	1130.7500	758.5550	493.6713	517.6623	810.0562	1217.0456	1605.2797	1934.2607	(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	(97a)
Space heating kWh												
988.4466	795.7777	703.7027	457.0724	264.7598	0.0000	0.0000	0.0000	0.0000	435.6452	722.3570	1001.9127	(98)

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Space heating
Space heating per m2 (98) / (4) = 5369.6739 (98)
46.0166 (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 %) 90.3000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5946.4827 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	988.4466	795.7777	703.7027	457.0724	264.7598	0.0000	0.0000	0.0000	0.0000	435.6452	722.3570	1001.9127 (98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000 (210)
Space heating fuel (main heating system)	1094.6252	881.2599	779.2942	506.1710	293.2002	0.0000	0.0000	0.0000	0.0000	482.4420	799.9524	1109.5378 (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	210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673 (64)
Efficiency of water heater (217)m	88.2163	88.0616	87.7458	87.0748	85.7908	79.6000	79.6000	79.6000	79.6000	86.8814	87.8281	79.6000 (216)
Fuel for water heating, kWh/month	238.8574	210.7201	221.6749	199.6552	198.1479	190.1476	181.9744	200.5675	200.4906	207.5208	217.8058	232.7436 (219)
Water heating fuel used												2500.3056 (219)
Annual totals kWh/year												
Space heating fuel - main system												5946.4827 (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)												450.4543 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.60 * 677 * 1.00) =									-865.9262			-865.9262 (233)
Total delivered energy for all uses												8106.3164 (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	5946.4827	0.2160	1284.4403 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2500.3056	0.2160	540.0660 (264)
Space and water heating			1824.5063 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	450.4543	0.5190	233.7858 (268)
Energy saving/generation technologies			
PV Unit	-865.9262	0.5190	-449.4157 (269)
Total CO2, kg/year			1647.8014 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.1200 (273)

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

	DER	TFA	N	EF	CO2 emissions
Total Floor Area		116.6900			14.1200 ZC1
Assumed number of occupants			2.8496		116.6900
CO2 emission factor in Table 12 for electricity displaced from grid				0.5190	2.8496
CO2 emissions from appliances, equation (L14)					0.5190
CO2 emissions from cooking, equation (L16)					14.2617 ZC2
Total CO2 emissions					1.6059 ZC3
Residual CO2 emissions offset from biofuel CHP					29.9875 ZC4
Additional allowable electricity generation, kWh/m²/year					0.0000 ZC5
Resulting CO2 emissions offset from additional allowable electricity generation					0.0000 ZC6
Net CO2 emissions					0.0000 ZC7
					29.9875 ZC8

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SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000	/ (5) =	0.1356 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3856 (18)							
Number of sides sheltered										0 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					1.0000 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3856 (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	0.4917	0.4820	0.4724	0.4242	0.4146	0.3664	0.3664	0.3567	0.3856	0.4146	0.4338	0.4531	(22b)				
Effective ac	0.6209	0.6162	0.6116	0.5900	0.5859	0.5671	0.5671	0.5636	0.5744	0.5859	0.5941	0.6027	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1600	1.0000	2.1600		(26)					
TER Opening Type (Uw = 1.40)			21.3500	1.3258	28.3049		(27)					
Heat Loss Floor			59.5500	0.1300	7.7415		(28a)					
External Wall	161.4000	23.5100	137.8900	0.1800	24.8202		(29a)					
External Roof	59.5500		59.5500	0.1300	7.7415		(30)					
Total net area of external elements Aum(A, m2)			280.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	70.7681		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.7632 (36)					
Total fabric heat loss						(33) + (36) =	86.5313 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.4243	Feb 59.9675	Mar 59.5198	Apr 57.4167	May 57.0232	Jun 55.1915	Jul 55.1915	Aug 54.8522	Sep 55.8970	Oct 57.0232	Nov 57.8192	Dec 58.6514 (38)
Heat transfer coeff	146.9556	146.4988	146.0511	143.9480	143.5545	141.7228	141.7228	141.3836	142.4283	143.5545	144.3505	145.1827 (39)
Average = Sum(39)m / 12 =												143.9461 (39)
HLP	Jan 1.2594	Feb 1.2555	Mar 1.2516	Apr 1.2336	May 1.2302	Jun 1.2145	Jul 1.2145	Aug 1.2116	Sep 1.2206	Oct 1.2302	Nov 1.2370	Dec 1.2442 (40)
HLP (average)												1.2336 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
Daily hot water use	Jan 112.0649	Feb 107.9898	Mar 103.9147	Apr 99.8396	May 95.7645	Jun 91.6894	Jul 91.6894	Aug 95.7645	Sep 99.8396	Oct 103.9147	Nov 107.9898	Dec 112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)												Total = Sum(45)m = 1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520 (48)
Temperature factor from Table 2b												0.5400 (49)

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Enter (49) or (54) in (55)												0.8381 (55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	215.4316	189.8272	199.2308	178.4175	174.7131	155.9257	149.5721	164.3722	164.1587	185.0174	195.8630	210.1878 (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	215.4316	189.8272	199.2308	178.4175	174.7131	155.9257	149.5721	164.3722	164.1587	185.0174	195.8630	210.1878 (64)
Heat gains from water heating, kWh/month	94.6520	83.9107	89.2652	81.6021	81.1131	74.1236	72.7537	77.6747	76.8611	84.5392	87.4028	92.9084 (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	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.5066	22.6547	18.4241	13.9482	10.4264	8.8024	9.5113	12.3632	16.5939	21.0697	24.5915	26.2155 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	280.8392	283.7534	276.4096	260.7756	241.0405	222.4922	210.1009	207.1866	214.5304	230.1644	249.8996	268.4478 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478 (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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826 (71)
Water heating gains (Table 5)	127.2204	124.8670	119.9801	113.3363	109.0229	102.9495	97.7872	104.4015	106.7515	113.6280	121.3927	124.8769 (72)
Total internal gains	502.3096	500.0187	483.5573	456.8036	429.2333	402.9876	386.1429	392.6948	406.6193	433.6057	464.6273	488.2837 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast				0.9600	11.2829		0.6300	0.7000	0.7700		3.3103 (75)	
East				0.8700	19.6403		0.6300	0.7000	0.7700		5.2220 (76)	
Southeast				5.8800	36.7938		0.6300	0.7000	0.7700		66.1187 (77)	
South				1.7300	46.7521		0.6300	0.7000	0.7700		24.7183 (78)	
Southwest				2.9300	36.7938		0.6300	0.7000	0.7700		32.9469 (79)	
West				0.8700	19.6403		0.6300	0.7000	0.7700		5.2220 (80)	
Northwest				8.1100	11.2829		0.6300	0.7000	0.7700		27.9650 (81)	

Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680 (83)
Total gains	667.8128	793.3387	914.3539	1038.6020	1123.7392	1111.0526	1061.0798	980.8806	889.3805	765.8116	664.9595	628.5517 (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	55.1423	55.3142	55.4838	56.2944	56.4487	57.1783	57.1783	57.3155	56.8951	56.4487	56.1375	55.8157
alpha	4.6762	4.6876	4.6989	4.7530	4.7632	4.8119	4.8119	4.8210	4.7930	4.7632	4.7425	4.7210
util living area	0.9983	0.9960	0.9889	0.9636	0.8894	0.7348	0.5680	0.6291	0.8659	0.9793	0.9964	0.9988 (86)
MIT	19.5895	19.7614	20.0411	20.4125	20.7337	20.9279	20.9834	20.9735	20.8311	20.4106	19.9353	19.5668 (87)
Th 2	19.8728	19.8759	19.8789	19.8932	19.8959	19.9084	19.9084	19.9107	19.9036	19.8959	19.8905	19.8848 (88)
util rest of house	0.9978	0.9946	0.9848	0.9490	0.8449	0.6398	0.4370	0.4965	0.7958	0.9685	0.9949	0.9983 (89)
MIT 2	17.9979	18.2510	18.6596	19.2003	19.6320	19.8600	19.9024	19.8998	19.7652	19.2072	18.5157	17.9730 (90)
Living area fraction	18.2963	18.5342	18.9186	19.4276	19.8386	20.0603	20.1051	20.1011	19.9651	19.4328	18.7819	18.2718 (92)
MIT	18.2963	18.5342	18.9186	19.4276	19.8386	20.0603	20.1051	20.1011	19.9651	19.4328	18.7819	18.2718 (93)
Temperature adjustment	18.2963	18.5342	18.9186	19.4276	19.8386	20.0603	20.1051	20.1011	19.9651	19.4328	18.7819	18.2718 (93)
adjusted MIT	18.2963	18.5342	18.9186	19.4276	19.8386	20.0603	20.1051	20.1011	19.9651	19.4328	18.7819	18.2718 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9965	0.9920	0.9797	0.9411	0.8422	0.6542	0.4616	0.5211	0.8005	0.9621	0.9926	0.9973 (94)
Ext temp.	665.4666	786.9976	895.8365	977.3905	946.3769	726.9019	489.8096	511.1620	711.9219	736.7604	660.0562	626.8831 (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	2056.8420	1997.3939	1813.7515	1515.4259	1168.3355	773.8441	496.7465	523.2785	835.3549	1267.9910	1686.2896	2042.9893 (97)
Space heating kWh	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	1035.1833	813.3863	682.9288	387.3854	165.1372	0.0000	0.0000	0.0000	0.0000	395.2356	738.8880	1053.5830 (98)
Space heating per m2												5271.7276 (98)
												(98) / (4) = 45.1772 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 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 %)													93.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5638.2113 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1035.1833	813.3863	682.9288	387.3854	165.1372	0.0000	0.0000	0.0000	0.0000	395.2356	738.8880	1053.5830	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1107.1479	869.9319	730.4051	414.3160	176.6173	0.0000	0.0000	0.0000	0.0000	422.7119	790.2546	1126.8267	(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	215.4316	189.8272	199.2308	178.4175	174.7131	155.9257	149.5721	164.3722	164.1587	185.0174	195.8630	210.1878	(64)
Efficiency of water heater (217)m	88.4569	88.2607	87.8400	86.8287	84.6640	79.8000	79.8000	79.8000	79.8000	86.7894	88.0268	79.8000	(216)
Fuel for water heating, kWh/month	243.5443	215.0756	226.8110	205.4821	206.3607	195.3956	187.4337	205.9802	205.7127	213.1797	222.5037	237.4311	(219)
Water heating fuel used												2564.9103	(219)
Annual totals kWh/year													
Space heating fuel - main system												5638.2113	(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)												450.4543	(232)
Total delivered energy for all uses												8728.5759	(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	5638.2113	0.2160	1217.8536 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2564.9103	0.2160	554.0206 (264)
Space and water heating			1771.8743 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	450.4543	0.5190	233.7858 (268)
Total CO2, kg/m2/year			2044.5850 (272)
Emissions per m2 for space and water heating			15.1845 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0035 (272b)
Emissions per m2 for pumps and fans			0.3336 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1845 * 1.00) + 2.0035 + 0.3336, rounded to 2 d.p.			17.5200 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (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) = 0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3846 (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	0.4904	0.4808	0.4712	0.4231	0.4135	0.3654	0.3654	0.3558	0.3846	0.4135	0.4327	0.4519 (22b)
Effective ac	0.6202	0.6156	0.6110	0.5895	0.5855	0.5668	0.5668	0.5633	0.5740	0.5855	0.5936	0.6021 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			9.0000	514.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	9143.7300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							78.3592 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss						(33) + (36) =	90.1722 (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	60.3634	59.9090	59.4635	57.3713	56.9799	55.1576	55.1576	54.8202	55.8595	56.9799	57.7718	58.5996 (38)
Heat transfer coeff	150.5356	150.0811	149.6357	147.5435	147.1521	145.3298	145.3298	144.9924	146.0317	147.1521	147.9439	148.7718 (39)
Average = Sum(39)m / 12 =												147.5416 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2900	1.2862	1.2823	1.2644	1.2611	1.2454	1.2454	1.2425	1.2515	1.2611	1.2678	1.2749 (40)
HLP (average)												1.2644 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)												Total = Sum(45)m = 1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
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	35.3152	30.8869	31.8725	27.7872	26.6625	23.0077	21.3200	24.4650	24.7572	28.8521	31.4944	34.2008	(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	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.5066	22.6547	18.4241	13.9482	10.4264	8.8024	9.5113	12.3632	16.5939	21.0697	24.5915	26.2155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	280.8392	283.7534	276.4096	260.7756	241.0405	222.4922	210.1009	207.1866	214.5304	230.1644	249.8996	268.4478	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	(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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	(71)
Water heating gains (Table 5)	47.4666	45.9626	42.8393	38.5933	35.8367	31.9551	28.6559	32.8831	34.3850	38.7798	43.7422	45.9689	(72)
Total internal gains	419.5558	418.1142	403.4165	379.0606	353.0471	328.9933	314.0116	318.1764	331.2528	355.7574	383.9767	406.3757	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
Northeast				0.9600	11.2829		0.6300	0.7000	0.7700		3.3103 (75)	
East				0.8700	19.6403		0.6300	0.7000	0.7700		5.2220 (76)	
Southeast				5.8800	36.7938		0.6300	0.7000	0.7700		66.1187 (77)	
South				1.7300	46.7521		0.6300	0.7000	0.7700		24.7183 (78)	
Southwest				2.9300	36.7938		0.6300	0.7000	0.7700		32.9469 (79)	
West				0.8700	19.6403		0.6300	0.7000	0.7700		5.2220 (80)	
Northwest				8.1100	11.2829		0.6300	0.7000	0.7700		27.9650 (81)	
Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680 (83)
Total gains	585.0591	711.4343	834.2132	960.8590	1047.5529	1037.0583	988.9485	906.3622	814.0140	687.9633	584.3090	546.6437 (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	16.8726	16.9237	16.9741	17.2148	17.2605	17.4770	17.4770	17.5176	17.3930	17.2605	17.1682	17.0726	17.0726	
alpha	2.1248	2.1282	2.1316	2.1477	2.1507	2.1651	2.1651	2.1678	2.1595	2.1507	2.1445	2.1382	2.1382	
util living area	0.9650	0.9465	0.9155	0.8577	0.7681	0.6461	0.5278	0.5750	0.7529	0.8928	0.9509	0.9694	0.9694	(86)
MIT	17.7501	18.0900	18.6492	19.3819	20.0495	20.5590	20.8008	20.7525	20.3321	19.4556	18.4767	17.6978	17.6978	(87)
Th 2	19.8486	19.8517	19.8547	19.8688	19.8715	19.8838	19.8838	19.8861	19.8791	19.8715	19.8661	19.8605	19.8605	(88)
util rest of house	0.9601	0.9391	0.9032	0.8355	0.7283	0.5771	0.4253	0.4751	0.6957	0.8714	0.9428	0.9651	0.9651	(89)
MIT 2	16.8829	17.2206	17.7733	18.4959	19.1306	19.5965	19.7878	19.7591	19.4094	18.5823	17.6169	16.8386	16.8386	(90)
Living area fraction										fLA = Living area / (4) =		0.1875	0.1875	(91)
MIT	17.0455	17.3836	17.9375	18.6620	19.3029	19.7770	19.9777	19.9454	19.5824	18.7461	17.7781	16.9997	16.9997	(92)
Temperature adjustment												0.0000	0.0000	
adjusted MIT	17.0455	17.3836	17.9375	18.6620	19.3029	19.7770	19.9777	19.9454	19.5824	18.7461	17.7781	16.9997	16.9997	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9429	0.9170	0.8762	0.8063	0.7048	0.5696	0.4348	0.4811	0.6778	0.8438	0.9219	0.9496	(94)
Useful gains	551.6400	652.3798	730.9059	774.7074	738.2753	590.7439	429.9937	436.0395	551.7432	580.4739	538.6845	519.0658	(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	1918.6450	1873.5525	1711.4575	1440.3197	1118.7795	752.3696	490.8868	514.0550	800.6110	1198.7101	1579.7673	1904.2377	(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	1017.0517	820.6281	729.5304	479.2409	283.0952	0.0000	0.0000	0.0000	0.0000	459.9678	749.5796	1030.5679	(98)
Space heating												5569.6615	(98)
Space heating per m2												(98) / (4) =	47.7304 (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	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1366.1002	1075.4406	1101.9419	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6737	0.7380	0.7053	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	920.3443	793.7209	777.1771	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1325.5859	1266.8432	1172.4531	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	291.7740	352.0030	294.0853	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												937.8623	(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	72.9435	88.0008	73.5213	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												234.4656	(107)
Space cooling per m2												2.0093	(108)
Energy for space heating												47.7304	(99)
Energy for space cooling												2.0093	(108)
Total												49.7397	(109)
Dwelling Fabric Energy Efficiency (DFEE)												49.7	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000	/ (5) =	0.1356 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.3856 (18)							
Number of sides sheltered										0 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =					1.0000	(20)	
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3856	(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	0.4917	0.4820	0.4724	0.4242	0.4146	0.3664	0.3664	0.3567	0.3856	0.4146	0.4338	0.4531	(22b)				
Effective ac	0.6209	0.6162	0.6116	0.5900	0.5859	0.5671	0.5671	0.5636	0.5744	0.5859	0.5941	0.6027	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1600	1.0000	2.1600		(26)					
TER Opening Type (Uw = 1.40)			21.3500	1.3258	28.3049		(27)					
Heat Loss Floor			59.5500	0.1300	7.7415		(28a)					
External Wall	161.4000	23.5100	137.8900	0.1800	24.8202		(29a)					
External Roof	59.5500		59.5500	0.1300	7.7415		(30)					
Total net area of external elements Aum(A, m2)			280.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	70.7681		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.7632 (36)					
Total fabric heat loss						(33) + (36) =	86.5313 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.4243	Feb 59.9675	Mar 59.5198	Apr 57.4167	May 57.0232	Jun 55.1915	Jul 55.1915	Aug 54.8522	Sep 55.8970	Oct 57.0232	Nov 57.8192	Dec 58.6514 (38)
Heat transfer coeff	146.9556	146.4988	146.0511	143.9480	143.5545	141.7228	141.7228	141.3836	142.4283	143.5545	144.3505	145.1827 (39)
Average = Sum(39)m / 12 =												143.9461 (39)
HLP	Jan 1.2594	Feb 1.2555	Mar 1.2516	Apr 1.2336	May 1.2302	Jun 1.2145	Jul 1.2145	Aug 1.2116	Sep 1.2206	Oct 1.2302	Nov 1.2370	Dec 1.2442 (40)
HLP (average)												1.2336 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
Daily hot water use	Jan 112.0649	Feb 107.9898	Mar 103.9147	Apr 99.8396	May 95.7645	Jun 91.6894	Jul 91.6894	Aug 95.7645	Sep 99.8396	Oct 103.9147	Nov 107.9898	Dec 112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)												Total = Sum(45)m = 1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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 (57)
Heat gains from water heating, kWh/month	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)
	35.3152	30.8869	31.8725	27.7872	26.6625	23.0077	21.3200	24.4650	24.7572	28.8521	31.4944	34.2008 (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	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782	142.4782 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.5066	22.6547	18.4241	13.9482	10.4264	8.8024	9.5113	12.3632	16.5939	21.0697	24.5915	26.2155 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	280.8392	283.7534	276.4096	260.7756	241.0405	222.4922	210.1009	207.1866	214.5304	230.1644	249.8996	268.4478 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478	37.2478 (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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826 (71)
Water heating gains (Table 5)	47.4666	45.9626	42.8393	38.5933	35.8367	31.9551	28.6559	32.8831	34.3850	38.7798	43.7422	45.9689 (72)
Total internal gains	419.5558	418.1142	403.4165	379.0606	353.0471	328.9933	314.0116	318.1764	331.2528	355.7574	383.9767	406.3757 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
Northeast				0.9600	11.2829	0.6300	0.7000	0.7700		3.3103 (75)		
East				0.8700	19.6403	0.6300	0.7000	0.7700		5.2220 (76)		
Southeast				5.8800	36.7938	0.6300	0.7000	0.7700		66.1187 (77)		
South				1.7300	46.7521	0.6300	0.7000	0.7700		24.7183 (78)		
Southwest				2.9300	36.7938	0.6300	0.7000	0.7700		32.9469 (79)		
West				0.8700	19.6403	0.6300	0.7000	0.7700		5.2220 (80)		
Northwest				8.1100	11.2829	0.6300	0.7000	0.7700		27.9650 (81)		
Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680 (83)
Total gains	585.0591	711.4343	834.2132	960.8590	1047.5529	1037.0583	988.9485	906.3622	814.0140	687.9633	584.3090	546.6437 (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	55.1423	55.3142	55.4838	56.2944	56.4487	57.1783	57.1783	57.3155	56.8951	56.4487	56.1375	55.8157
alpha	4.6762	4.6876	4.6989	4.7530	4.7632	4.8119	4.8119	4.8210	4.7930	4.7632	4.7425	4.7210
util living area	0.9991	0.9975	0.9924	0.9726	0.9099	0.7682	0.6034	0.6697	0.8952	0.9864	0.9980	0.9993 (86)
MIT	19.5246	19.6978	19.9807	20.3600	20.6971	20.9122	20.9786	20.9655	20.7981	20.3540	19.8723	19.5023 (87)
Th 2	19.8728	19.8759	19.8789	19.8932	19.8959	19.9084	19.9084	19.9107	19.9036	19.8959	19.8905	19.8848 (88)
util rest of house	0.9987	0.9966	0.9894	0.9611	0.8708	0.6751	0.4672	0.5336	0.8337	0.9789	0.9971	0.9991 (89)
MIT 2	18.5280	18.7033	18.9871	19.3708	19.6862	19.8669	19.9029	19.9006	19.7860	19.3715	18.8893	18.5151 (90)
Living area fraction									fLA = Living area / (4) =			0.1875 (91)
MIT	18.7149	18.8898	19.1734	19.5563	19.8757	20.0629	20.1046	20.1003	19.9758	19.5558	19.0736	18.7002 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7149	18.8898	19.1734	19.5563	19.8757	20.0629	20.1046	20.1003	19.9758	19.5558	19.0736	18.7002 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9982	0.9954	0.9869	0.9566	0.8699	0.6898	0.4930	0.5592	0.8386	0.9757	0.9961	0.9987 (94)
Ext temp.	584.0261	708.1683	823.2648	919.1730	911.2737	715.3801	487.5239	506.8574	682.6587	671.2363	582.0464	545.9475 (95)
Ext loss	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	2118.3470	2049.4823	1850.9626	1533.9544	1173.6621	774.2189	496.6842	523.1588	836.8763	1285.6404	1728.3956	2105.1840 (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	1141.5347	901.3630	764.6072	442.6426	195.2170	0.0000	0.0000	0.0000	0.0000	457.1166	825.3714	1160.0720 (98)
Space heating												5887.9246 (98)
Space heating per m2												50.4578 (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	1332.1941	1048.7486	1074.5151	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8259	0.8959	0.8622	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1100.2243	939.6081	926.4758	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1325.5859	1266.8432	1172.4531	0.0000	0.0000	0.0000	0.0000 (103)

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Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Month fraction	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	162.2604	243.4629	183.0071	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												588.7304 (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	40.5651	60.8657	45.7518	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												147.1826 (107)
Space cooling per m2												1.2613 (108)
Energy for space heating												50.4578 (99)
Energy for space cooling												1.2613 (108)
Total												51.7191 (109)
Target Fabric Energy Efficiency (TFEE)												59.5 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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) =	0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3846 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.4000	4.1000	4.1000	3.9000	3.9000	3.7000	3.7000	3.5000	3.5000	3.8000	3.7000	3.9000 (22)
Wind factor	1.1000	1.0250	1.0250	0.9750	0.9750	0.9250	0.9250	0.8750	0.8750	0.9500	0.9250	0.9750 (22a)
Adj infilt rate	0.4231	0.3942	0.3942	0.3750	0.3750	0.3558	0.3558	0.3366	0.3366	0.3654	0.3558	0.3750 (22b)
Effective ac	0.5895	0.5777	0.5777	0.5703	0.5703	0.5633	0.5633	0.5566	0.5566	0.5668	0.5633	0.5703 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss						(33) + (36) =	90.1722 (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	57.3713	56.2240	56.2240	55.5041	55.5041	54.8202	54.8202	54.1723	54.1723	55.1576	54.8202	55.5041 (38)
Heat transfer coeff	147.5435	146.3962	146.3962	145.6763	145.6763	144.9924	144.9924	144.3445	144.3445	145.3298	144.9924	145.6763 (39)
Average = Sum(39)m / 12 =												145.5300 (39)
HLP	1.2644	1.2546	1.2546	1.2484	1.2484	1.2425	1.2425	1.2370	1.2370	1.2454	1.2425	1.2484 (40)
HLP (average)												1.2472 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)										Total = Sum(45)m =		1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Water storage loss:											
Store volume											
a) If manufacturer declared loss factor is known (kWh/day):											
Temperature factor from Table 2b											
Enter (49) or (54) in (55)											
Total storage loss											
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598 (56)
If cylinder contains dedicated solar storage											
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month											
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673 (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 (63)
Output from w/h											
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
90.8756	80.4997	85.4888	77.9476	77.3367	70.4691	68.9773	73.8983	73.2065	80.7629	83.7482	89.1320 (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	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.7665	56.6368	46.0601	34.8705	26.0661	22.0061	23.7784	30.9080	41.4847	52.6743	61.4787	65.5387 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	419.1630	423.5126	412.5517	389.2174	359.7619	332.0780	313.5834	309.2338	320.1946	343.5290	372.9844	400.6684 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470 (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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826 (71)
Water heating gains (Table 5)	122.1446	119.7913	114.9043	108.2605	103.9472	97.8737	92.7114	99.3257	101.6758	108.5522	116.3170	119.8011 (72)
Total internal gains	720.0123	714.8789	688.4544	647.2866	604.7134	566.8960	545.0114	554.4058	578.2933	619.6938	665.7184	700.9465 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
Northeast					0.9600	14.6176	0.6300	0.7000			0.7700			4.2887 (75)
East					0.8700	25.1925	0.6300	0.7000			0.7700			6.6983 (76)
Southeast					5.8800	45.1778	0.6300	0.7000			0.7700			81.1848 (77)
South					1.7300	56.7559	0.6300	0.7000			0.7700			30.0074 (78)
Southwest					2.9300	45.1778	0.6300	0.7000			0.7700			40.4543 (79)
West					0.8700	25.1925	0.6300	0.7000			0.7700			6.6983 (80)
Northwest					8.1100	14.6176	0.6300	0.7000			0.7700			36.2302 (81)
Solar gains		205.5618	310.9263	462.8436	632.9747	717.4402	803.0365	738.0997	669.2847	545.1904	375.8118	248.1849	164.8169	(83)
Total gains		925.5741	1025.8052	1151.2980	1280.2613	1322.1536	1369.9325	1283.1112	1223.6905	1123.4837	995.5057	913.9033	865.7634	(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	18.1829	18.3254	18.3254	18.4160	18.4160	18.5029	18.5029	18.5859	18.5859	18.4599	18.5029	18.4160
alpha	2.2122	2.2217	2.2217	2.2277	2.2277	2.2335	2.2335	2.2391	2.2391	2.2307	2.2335	2.2277
util living area	0.9158	0.8937	0.8459	0.7634	0.6411	0.4672	0.3460	0.3591	0.5788	0.7783	0.8809	0.9237 (86)
MIT	18.6215	18.8759	19.3782	19.9715	20.5011	20.8361	20.9430	20.9390	20.7149	20.1216	19.3149	18.6003 (87)
Th 2	19.8688	19.8766	19.8766	19.9715	19.8815	19.8861	19.8861	19.8905	19.8905	19.8838	19.8861	19.8815 (88)
util rest of house	0.9043	0.8794	0.8246	0.7296	0.5853	0.3841	0.2388	0.2490	0.4992	0.7374	0.8621	0.9130 (89)
MIT 2	17.7459	17.9984	18.4846	19.0497	19.5293	19.8007	19.8686	19.8716	19.7224	19.2057	18.4389	17.7348 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	17.9101	18.1629	18.6521	19.2226	19.7115	19.9948	20.0701	20.0717	19.9085	19.3774	18.6032	17.8971 (92)
Temperature adjustment												
adjusted MIT	17.9101	18.1629	18.6521	19.2226	19.7115	19.9948	20.0701	20.0717	19.9085	19.3774	18.6032	17.8971 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8785	0.8520	0.7966	0.7067	0.5760	0.3927	0.2573	0.2679	0.5006	0.7157	0.8349	0.8884 (94)
Useful gains	813.1012	873.9890	917.1503	904.7020	761.4950	538.0105	330.1823	327.8779	562.4711	712.4443	762.9751	769.1458 (95)
Ext temp.	5.4000	5.9000	7.6000	10.0000	13.1000	15.9000	17.7000	17.7000	15.3000	12.0000	8.4000	5.5000 (96)
Heat loss rate W	1845.7839	1795.2465	1617.9919	1343.5080	963.1388	593.7207	343.6398	342.3435	665.2106	1072.1626	1479.3827	1805.9610 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

	768.3159	619.0851	521.4262	315.9403	150.0229	0.0000	0.0000	0.0000	0.0000	267.6304	515.8135	771.3905 (98)
Space heating												3929.6250 (98)
RHI space heating demand												3930 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (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) = 0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3846 (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	0.4904	0.4808	0.4712	0.4231	0.4135	0.3654	0.3654	0.3558	0.3846	0.4135	0.4327	0.4519 (22b)
Effective ac	0.6202	0.6156	0.6110	0.5895	0.5855	0.5668	0.5668	0.5633	0.5740	0.5855	0.5936	0.6021 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss							(33) + (36) = 90.1722 (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	60.3634	59.9090	59.4635	57.3713	56.9799	55.1576	55.1576	54.8202	55.8595	56.9799	57.7718	58.5996 (38)
Heat transfer coeff	150.5356	150.0811	149.6357	147.5435	147.1521	145.3298	145.3298	144.9924	146.0317	147.1521	147.9439	148.7718 (39)
Average = Sum(39)m / 12 =												147.5416 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2900	1.2862	1.2823	1.2644	1.2611	1.2454	1.2454	1.2425	1.2515	1.2611	1.2678	1.2749 (40)
HLP (average)												1.2644 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)												Total = Sum(45)m = 1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water storage loss:	24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6858 (55)
Total storage loss												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(56)
If cylinder contains dedicated solar storage												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	(59)
Total heat required for water heating calculated for each month												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(64)
Heat gains from water heating, kWh/month												
90.8756	80.4997	85.4888	77.9476	77.3367	70.4691	68.9773	73.8983	73.2065	80.7629	83.7482	89.1320	(65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
63.7665	56.6368	46.0601	34.8705	26.0661	22.0061	23.7784	30.9080	41.4847	52.6743	61.4787	65.5387	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
419.1630	423.5126	412.5517	389.2174	359.7619	332.0780	313.5834	309.2338	320.1946	343.5290	372.9844	400.6684	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	(71)
Water heating gains (Table 5)												
122.1446	119.7913	114.9043	108.2605	103.9472	97.8737	92.7114	99.3257	101.6758	108.5522	116.3170	119.8011	(72)
Total internal gains												
720.0123	714.8789	688.4544	647.2866	604.7134	566.8960	545.0114	554.4058	578.2933	619.6938	665.7184	700.9465	(73)

6. Solar gains

[Jan]				Area	Solar flux	g		FF	Access		Gains	
				m2	Table 6a	or Table 6b		Specific data	factor		W	
					W/m2			or Table 6c	Table 6d			
Northeast				0.9600	11.2829	0.6300		0.7000	0.7700		3.3103 (75)	
East				0.8700	19.6403	0.6300		0.7000	0.7700		5.2220 (76)	
Southeast				5.8800	36.7938	0.6300		0.7000	0.7700		66.1187 (77)	
South				1.7300	46.7521	0.6300		0.7000	0.7700		24.7183 (78)	
Southwest				2.9300	36.7938	0.6300		0.7000	0.7700		32.9469 (79)	
West				0.8700	19.6403	0.6300		0.7000	0.7700		5.2220 (80)	
Northwest				8.1100	11.2829	0.6300		0.7000	0.7700		27.9650 (81)	
Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680 (83)
Total gains	885.5155	1008.1989	1119.2511	1229.0850	1299.2193	1274.9610	1219.9483	1142.5916	1061.0546	951.8998	866.0506	841.2145 (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	17.8215	17.8755	17.9287	18.1829	18.2313	18.4599	18.4599	18.5029	18.3712	18.2313	18.1337	18.0328
alpha	2.1881	2.1917	2.1952	2.2122	2.2154	2.2307	2.2307	2.2335	2.2247	2.2154	2.2089	2.2022
util living area	0.9315	0.9086	0.8713	0.8047	0.7067	0.5767	0.4568	0.4952	0.6719	0.8313	0.9086	0.9378 (86)
MIT	18.2630	18.5655	19.0588	19.6976	20.2624	20.6790	20.8645	20.8332	20.5156	19.7896	18.9260	18.2129 (87)
Th 2	19.8486	19.8517	19.8547	19.8688	19.8715	19.8838	19.8838	19.8861	19.8791	19.8715	19.8661	19.8605 (88)
util rest of house	0.9224	0.8966	0.8538	0.7770	0.6619	0.5063	0.3604	0.3994	0.6080	0.8014	0.8946	0.9295 (89)
MIT 2	17.3794	17.6772	18.1603	18.7836	19.3106	19.6823	19.8218	19.8051	19.5524	18.8864	18.0464	17.3383 (90)
Living area fraction										fLA = Living area / (4) =	0.1875 (91)	0.1875 (91)
MIT	17.5451	17.8438	18.3288	18.9550	19.4891	19.8692	20.0174	19.9979	19.7330	19.0557	18.2113	17.5023 (92)
Temperature adjustment												0.0000
adjusted MIT	17.5451	17.8438	18.3288	18.9550	19.4891	19.8692	20.0174	19.9979	19.7330	19.0557	18.2113	17.5023 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8982	0.8697	0.8251	0.7506	0.6449	0.5053	0.3727	0.4098	0.5986	0.7752	0.8683	0.9066 (94)
Useful gains	795.3947	876.8124	923.5475	922.5793	837.8100	644.2783	454.6778	468.2240	635.1975	737.8803	751.9722	762.6320 (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	1993.8582	1942.6166	1770.0130	1483.5505	1146.1803	765.7704	496.6440	521.6668	822.5935	1244.2810	1643.8503	1979.0043 (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	891.6568	716.2205	629.7703	403.8993	229.4275	0.0000	0.0000	0.0000	0.0000	376.7621	642.1522	904.9810 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating
Space heating per m2 (98) / (4) = 4794.8695 (98)
41.0907 (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 %) 90.3000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 5309.9330 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	891.6568	716.2205	629.7703	403.8993	229.4275	0.0000	0.0000	0.0000	0.0000	376.7621	642.1522	904.9810	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	987.4383	793.1566	697.4200	447.2860	254.0725	0.0000	0.0000	0.0000	0.0000	417.2338	711.1320	1002.1938	(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	210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(64)
Efficiency of water heater (217)m	88.0380	87.8695	87.5237	86.7895	85.4135	79.6000	79.6000	79.6000	79.6000	86.5351	87.5974	88.1085	(216)
Fuel for water heating, kWh/month	239.3413	211.1809	222.2373	200.3115	199.0232	190.1476	181.9744	200.5675	200.4906	208.3512	218.3796	233.1980	(219)
Water heating fuel used												2505.2029	(219)
Annual totals kWh/year													
Space heating fuel - main system												5309.9330	(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)												450.4543	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.60 * 677 * 1.00) =									-865.9262			-865.9262	(233)
Total delivered energy for all uses												7474.6640	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5309.9330	3.4800	184.7857	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2505.2029	3.4800	87.1811	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	450.4543	13.1900	59.4149	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-865.9262	13.1900	-114.2157	(252)
Total energy cost			347.0585	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.9015 (257)
SAP value 87.4240
SAP rating (Section 12) 87 (258)
SAP band B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5309.9330	0.2160	1146.9455	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2505.2029	0.2160	541.1238	(264)
Space and water heating			1688.0694	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	450.4543	0.5190	233.7858	(268)
Energy saving/generation technologies				
PV Unit	-865.9262	0.5190	-449.4157	(269)
Total kg/year			1511.3644	(272)
CO2 emissions per m2			12.9500	(273)
EI value			87.4746	
EI rating			87	(274)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band

B

Calculation of stars for heating and DHW	

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9030 = 3.854$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9030 = 0.2392$, stars = 4
Water heating energy efficiency	$3.48 / 0.8469 = 4.109$, stars = 4
Water heating environmental impact	$0.216 / 0.8469 = 0.2550$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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) = 0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =				1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.3846 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.4000	4.1000	4.1000	3.9000	3.9000	3.7000	3.7000	3.5000	3.5000	3.8000	3.7000	3.9000 (22)
Wind factor	1.1000	1.0250	1.0250	0.9750	0.9750	0.9250	0.9250	0.8750	0.8750	0.9500	0.9250	0.9750 (22a)
Adj infilt rate	0.4231	0.3942	0.3942	0.3750	0.3750	0.3558	0.3558	0.3366	0.3366	0.3654	0.3558	0.3750 (22b)
Effective ac	0.5895	0.5777	0.5777	0.5703	0.5703	0.5633	0.5633	0.5566	0.5566	0.5668	0.5633	0.5703 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss						(33) + (36) =	90.1722 (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	57.3713	56.2240	56.2240	55.5041	55.5041	54.8202	54.8202	54.1723	54.1723	55.1576	54.8202	55.5041 (38)
Heat transfer coeff	147.5435	146.3962	146.3962	145.6763	145.6763	144.9924	144.9924	144.3445	144.3445	145.3298	144.9924	145.6763 (39)
Average = Sum(39)m / 12 =												145.5300 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2644	1.2546	1.2546	1.2484	1.2484	1.2425	1.2425	1.2370	1.2370	1.2454	1.2425	1.2484 (40)
HLP (average)												1.2472 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)										Total = Sum(45)m =		1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Water storage loss:	24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6858 (55)
Total storage loss												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(56)
If cylinder contains dedicated solar storage												
21.2598	19.2024	21.2598	20.5740	21.2598	20.5740	21.2598	21.2598	20.5740	21.2598	20.5740	21.2598	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(64)
Heat gains from water heating, kWh/month												
90.8756	80.4997	85.4888	77.9476	77.3367	70.4691	68.9773	73.8983	73.2065	80.7629	83.7482	89.1320	(65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
63.7665	56.6368	46.0601	34.8705	26.0661	22.0061	23.7784	30.9080	41.4847	52.6743	61.4787	65.5387	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
419.1630	423.5126	412.5517	389.2174	359.7619	332.0780	313.5834	309.2338	320.1946	343.5290	372.9844	400.6684	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	(71)
Water heating gains (Table 5)												
122.1446	119.7913	114.9043	108.2605	103.9472	97.8737	92.7114	99.3257	101.6758	108.5522	116.3170	119.8011	(72)
Total internal gains												
720.0123	714.8789	688.4544	647.2866	604.7134	566.8960	545.0114	554.4058	578.2933	619.6938	665.7184	700.9465	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.9600	14.6176	0.6300	0.7000	0.7700	4.2887 (75)
East	0.8700	25.1925	0.6300	0.7000	0.7700	6.6983 (76)
Southeast	5.8800	45.1778	0.6300	0.7000	0.7700	81.1848 (77)
South	1.7300	56.7559	0.6300	0.7000	0.7700	30.0074 (78)
Southwest	2.9300	45.1778	0.6300	0.7000	0.7700	40.4543 (79)
West	0.8700	25.1925	0.6300	0.7000	0.7700	6.6983 (80)
Northwest	8.1100	14.6176	0.6300	0.7000	0.7700	36.2302 (81)

Solar gains	205.5618	310.9263	462.8436	632.9747	717.4402	803.0365	738.0997	669.2847	545.1904	375.8118	248.1849	164.8169 (83)
Total gains	925.5741	1025.8052	1151.2980	1280.2613	1322.1536	1369.9325	1283.1112	1223.6905	1123.4837	995.5057	913.9033	865.7634 (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	18.1829	18.3254	18.3254	18.4160	18.4160	18.5029	18.5029	18.5859	18.5859	18.4599	18.5029	18.4160
alpha	2.2122	2.2217	2.2217	2.2277	2.2277	2.2335	2.2335	2.2391	2.2391	2.2307	2.2335	2.2277
util living area												
	0.9158	0.8937	0.8459	0.7634	0.6411	0.4672	0.3460	0.3591	0.5788	0.7783	0.8809	0.9237 (86)
MIT	18.6215	18.8759	19.3782	19.9715	20.5011	20.8361	20.9430	20.9390	20.7149	20.1216	19.3149	18.6003 (87)
Th 2	19.8688	19.8766	19.8766	19.8815	19.8815	19.8861	19.8861	19.8905	19.8905	19.8838	19.8861	19.8815 (88)
util rest of house												
	0.9043	0.8794	0.8246	0.7296	0.5853	0.3841	0.2388	0.2490	0.4992	0.7374	0.8621	0.9130 (89)
MIT 2	17.7459	17.9984	18.4846	19.0497	19.5293	19.8007	19.8686	19.8716	19.7224	19.2057	18.4389	17.7348 (90)
Living area fraction												
MIT	17.9101	18.1629	18.6521	19.2226	19.7115	19.9948	20.0701	20.0717	19.9085	19.3774	18.6032	17.8971 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9101	18.1629	18.6521	19.2226	19.7115	19.9948	20.0701	20.0717	19.9085	19.3774	18.6032	17.8971 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8785	0.8520	0.7966	0.7067	0.5760	0.3927	0.2573	0.2679	0.5006	0.7157	0.8349	0.8884 (94)
Useful gains	813.1012	873.9890	917.1503	904.7020	761.4950	538.0105	330.1823	327.8779	562.4711	712.4443	762.9751	769.1458 (95)
Ext temp.	5.4000	5.9000	7.6000	10.0000	13.1000	15.9000	17.7000	17.7000	15.3000	12.0000	8.4000	5.5000 (96)
Heat loss rate W												
	1845.7839	1795.2465	1617.9919	1343.5080	963.1388	593.7207	343.6398	342.3435	665.2106	1072.1626	1479.3827	1805.9610 (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												
	768.3159	619.0851	521.4262	315.9403	150.0229	0.0000	0.0000	0.0000	0.0000	267.6304	515.8135	771.3905 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Space heating 3929.6250 (98)
Space heating per m2 (98) / (4) = 33.6758 (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 %)	90.3000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4351.7441 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	768.3159	619.0851	521.4262	315.9403	150.0229	0.0000	0.0000	0.0000	0.0000	267.6304	515.8135	771.3905	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	850.8482	685.5870	577.4376	349.8785	166.1384	0.0000	0.0000	0.0000	0.0000	296.3792	571.2221	854.2531	(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	210.7112	185.5635	194.5103	173.8493	169.9927	151.3575	144.8516	159.6517	159.5905	180.2970	191.2948	205.4673	(64)
Efficiency of water heater	87.7610	87.5849	87.1184	86.1877	84.2818	79.6000	79.6000	79.6000	79.6000	85.6649	87.1314	87.8171	(216)
Fuel for water heating, kWh/month	240.0966	211.8670	223.2713	201.7100	201.6955	190.1476	181.9744	200.5675	200.4906	210.4676	219.5474	233.9719	(219)
Water heating fuel used												2515.8074	(219)
Annual totals kWh/year													
Space heating fuel - main system												4351.7441	(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)												450.4543	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.60 * 776 * 1.00) =									-993.0186			-993.0186	(233)
Total delivered energy for all uses												6399.9872	(238)

10a. Fuel costs - using BEDF prices (511)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4351.7441	4.2600	185.3843	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2515.8074	4.2600	107.1734	(247)
Pumps and fans for heating	75.0000	22.5500	16.9125	(249)
Energy for lighting	450.4543	22.5500	101.5774	(250)
Additional standing charges			96.0000	(251)
Energy saving/generation technologies				
PV Unit	-993.0186	22.5500	-223.9257	(252)
Total energy cost			283.1219	(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	4351.7441	0.2160	939.9767	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.8074	0.2160	543.4144	(264)
Space and water heating			1483.3911	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	450.4543	0.5190	233.7858	(268)
Energy saving/generation technologies				
PV Unit	-993.0186	0.5190	-515.3766	(269)
Total kg/year			1240.7253	(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	4351.7441	1.2200	5309.1279	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2515.8074	1.2200	3069.2850	(264)
Space and water heating			8378.4128	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	450.4543	3.0700	1382.8946	(268)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Energy saving/generation technologies			
PV Unit	-993.0186	3.0700	-3048.5670 (269)
Primary energy kWh/year			6942.9904 (272)
Primary energy kWh/m2/year			59.4994 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 46	-264 kg (21.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£46	2.26 kg/m²	B 89 B 90
Total Savings	£46	2.26 kg/m²	

Potential energy efficiency rating:	B 89
Potential environmental impact rating:	B 90

Fuel prices for cost data on this page from database revision number 511 TEST (31 Jan 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£118	£130	-£11
Mains gas	£389	£331	£57
Space heating	£298	£299	-£1
Water heating	£107	£60	£47
Lighting	£102	£102	£0
Generated (PV)	-£224	-£224	£0
Total cost of fuels	£283	£237	£46
Total cost of uses	£283	£237	£46
Delivered energy	55 kWh/m²	44 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.2 tonnes	1.0 tonnes	0.3 tonnes
CO2 emissions per m²	11 kg/m²	8 kg/m²	2 kg/m²
Primary energy	59 kWh/m²	47 kWh/m²	13 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 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) =	0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3846 (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	0.4904	0.4808	0.4712	0.4231	0.4135	0.3654	0.3654	0.3558	0.3846	0.4135	0.4327	0.4519 (22b)
Effective ac	0.6202	0.6156	0.6110	0.5895	0.5855	0.5668	0.5668	0.5633	0.5740	0.5855	0.5936	0.6021 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss						(33) + (36) =	90.1722 (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	60.3634	59.9090	59.4635	57.3713	56.9799	55.1576	55.1576	54.8202	55.8595	56.9799	57.7718	58.5996 (38)
Heat transfer coeff	150.5356	150.0811	149.6357	147.5435	147.1521	145.3298	145.3298	144.9924	146.0317	147.1521	147.9439	148.7718 (39)
Average = Sum(39)m / 12 =												147.5416 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2900	1.2862	1.2823	1.2644	1.2611	1.2454	1.2454	1.2425	1.2515	1.2611	1.2678	1.2749 (40)
HLP (average)												1.2644 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)										Total = Sum(45)m =		1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Water storage loss:											190.0000 (47)
Store volume											1.3166 (48)
a) If manufacturer declared loss factor is known (kWh/day):											0.5400 (49)
Temperature factor from Table 2b											0.7110 (55)
Enter (49) or (54) in (55)											
Total storage loss											
22.0401	19.9072	22.0401	21.3291	22.0401	21.3291	22.0401	22.0401	21.3291	22.0401	21.3291	22.0401 (56)
If cylinder contains dedicated solar storage											
13.3401	12.0491	13.3401	12.9097	13.3401	12.9097	13.3401	13.3401	12.9097	13.3401	12.9097	13.3401 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	23.2624 (59)
Total heat required for water heating calculated for each month											
202.7914	178.4102	185.1948	159.4314	149.2786	131.0865	123.9049	139.6355	146.5234	170.9815	183.6305	197.5476 (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											1.1314 (H8)
Utilisation factor											0.5868 (H9)
Collector performance factor											0.8793 (H10)
Dedicated solar storage volume											75.0000 (H11)
Effective solar volume											109.5000 (H13)
Daily hot water demand											101.8772 (H14)
Volume ratio Veff/V											1.0748 (H15)
Solar storage volume factor											1.0000 (H16)
Solar input											-935.7703 (H17)
Solar input	-27.1355	-45.2813	-77.1192	-103.3550	-127.6864	-125.5361	-123.8770	-108.2320	-84.7674	-57.8861	-32.1866
Solar input (sum of months) = Sum (63)m =											-935.7703 (63)
Output from w/h											
175.6559	133.1289	108.0756	56.0764	21.5922	5.5504	0.0279	31.4035	61.7560	113.0953	151.4439	174.8398 (64)
Total per year (kWh/year) = Sum (64)m =											1032.6460 (64)
Heat gains from water heating, kWh/month											
84.5398	74.7771	78.0364	66.4133	60.7654	54.2523	52.2199	57.8854	62.7528	73.3105	77.6168	82.7962 (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	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.7665	56.6368	46.0601	34.8705	26.0661	22.0061	23.7784	30.9080	41.4847	52.6743	61.4787	65.5387	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	419.1630	423.5126	412.5517	389.2174	359.7619	332.0780	313.5834	309.2338	320.1946	343.5290	372.9844	400.6684	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	(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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	(71)
Water heating gains (Table 5)	113.6288	111.2754	104.8876	92.2407	81.6740	75.3504	70.1881	77.8029	87.1567	98.5356	107.8011	111.2852	(72)
Total internal gains	711.4964	706.3630	678.4378	631.2668	582.4402	544.3727	522.4881	532.8830	563.7743	609.6772	657.2025	692.4306	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.9600	11.2829	0.6300	0.7000	0.7700	3.3103 (75)
East	0.8700	19.6403	0.6300	0.7000	0.7700	5.2220 (76)
Southeast	5.8800	36.7938	0.6300	0.7000	0.7700	66.1187 (77)
South	1.7300	46.7521	0.6300	0.7000	0.7700	24.7183 (78)
Southwest	2.9300	36.7938	0.6300	0.7000	0.7700	32.9469 (79)
West	0.8700	19.6403	0.6300	0.7000	0.7700	5.2220 (80)
Northwest	8.1100	11.2829	0.6300	0.7000	0.7700	27.9650 (81)

Solar gains	165.5032	293.3201	430.7967	581.7984	694.5058	708.0650	674.9369	588.1858	482.7612	332.2059	200.3323	140.2680	(83)
Total gains	876.9996	999.6831	1109.2344	1213.0652	1276.9461	1252.4377	1197.4250	1121.0688	1046.5355	941.8831	857.5348	832.6986	(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	17.8215	17.8755	17.9287	18.1829	18.2313	18.4599	18.4599	18.5029	18.3712	18.2313	18.1337	18.0328
alpha	2.1881	2.1917	2.1952	2.2122	2.2154	2.2307	2.2307	2.2335	2.2247	2.2154	2.2089	2.2022
util living area	0.9327	0.9099	0.8731	0.8082	0.7125	0.5833	0.4633	0.5021	0.6767	0.8339	0.9101	0.9389 (86)
MIT	18.2518	18.5550	19.0479	19.6835	20.2488	20.6712	20.8605	20.8283	20.5079	19.7800	18.9155	18.2014 (87)
Th 2	19.8486	19.8517	19.8547	19.8688	19.8715	19.8838	19.8838	19.8861	19.8791	19.8715	19.8661	19.8605 (88)
util rest of house	0.9237	0.8980	0.8558	0.7808	0.6681	0.5128	0.3661	0.4056	0.6131	0.8043	0.8963	0.9308 (89)
MIT 2	17.3685	17.6672	18.1500	18.7709	19.2992	19.6769	19.8198	19.8025	19.5465	18.8777	18.0363	17.3271 (90)
Living area fraction	fLA = Living area / (4) =											0.1875 (91)

MIT	17.5341	17.8336	18.3184	18.9420	19.4773	19.8633	20.0149	19.9948	19.7268	19.0469	18.2012	17.4910 (92)
Temperature adjustment												0.0000
adjusted MIT	17.5341	17.8336	18.3184	18.9420	19.4773	19.8633	20.0149	19.9948	19.7268	19.0469	18.2012	17.4910 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5340.2314	0.2160	1153.4900 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1181.6327	0.2160	255.2327 (264)
Space and water heating			1408.7227 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	450.4543	0.5190	233.7858 (268)
Energy saving/generation technologies			
PV Unit	-865.9262	0.5190	-449.4157 (269)
Total kg/year			1257.9677 (272)
CO2 emissions per m2			10.7800 (273)
EI value			89.5746
EI rating			90 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	59.5500 (1b)	x 2.4000 (2b)	= 142.9200 (1b) - (3b)
First floor	57.1400 (1c)	x 2.6600 (2c)	= 151.9924 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	116.6900		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 294.9124 (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) =	0.1356 (8)
Pressure test					Yes
Measured/design AP50					4.9800
Infiltration rate					0.3846 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3846 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.4000	4.1000	4.1000	3.9000	3.9000	3.7000	3.7000	3.5000	3.5000	3.8000	3.7000	3.9000 (22)
Wind factor	1.1000	1.0250	1.0250	0.9750	0.9750	0.9250	0.9250	0.8750	0.8750	0.9500	0.9250	0.9750 (22a)
Adj infilt rate	0.4231	0.3942	0.3942	0.3750	0.3750	0.3558	0.3558	0.3366	0.3366	0.3654	0.3558	0.3750 (22b)
Effective ac	0.5895	0.5777	0.5777	0.5703	0.5703	0.5633	0.5633	0.5566	0.5566	0.5668	0.5633	0.5703 (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
Solid Doors			2.1600	1.4000	3.0240		(26)
Windows (Uw = 1.40)			21.3500	1.3258	28.3049		(27)
Heat Loss Floor			59.5500	0.1700	10.1235	75.0000	4466.2500 (28a)
External Wall	161.4000	23.5100	137.8900	0.2000	27.5780	9.0000	1241.0100 (29a)
External Roof	59.5500		59.5500	0.1000	5.9550	9.0000	535.9500 (30)
Total net area of external elements Aum(A, m ²)			280.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	74.9854		(33)
Internal Wall - GF			50.8800			9.0000	457.9200 (32c)
Internal Wall - FF			99.9800			9.0000	899.8200 (32c)
Internal Floor			57.1400			18.0000	1028.5200 (32d)
Internal Ceiling			57.1400			18.0000	1028.5200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	9657.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							82.7662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.1868 (36)
Total fabric heat loss						(33) + (36) =	90.1722 (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	57.3713	56.2240	56.2240	55.5041	55.5041	54.8202	54.8202	54.1723	54.1723	55.1576	54.8202	55.5041 (38)
Heat transfer coeff	147.5435	146.3962	146.3962	145.6763	145.6763	144.9924	144.9924	144.3445	144.3445	145.3298	144.9924	145.6763 (39)
Average = Sum(39)m / 12 =												145.5300 (39)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2644	1.2546	1.2546	1.2484	1.2484	1.2425	1.2425	1.2370	1.2370	1.2454	1.2425	1.2484 (40)
HLP (average)												1.2472 (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												2.8496 (42)
Average daily hot water use (litres/day)												101.8772 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.0649	107.9898	103.9147	99.8396	95.7645	91.6894	91.6894	95.7645	99.8396	103.9147	107.9898	112.0649 (44)
Energy conte	166.1890	145.3499	149.9881	130.7633	125.4705	108.2715	100.3294	115.1295	116.5045	135.7748	148.2088	160.9451 (45)
Energy content (annual)										Total = Sum(45)m =		1602.9244 (45)
Distribution loss (46)m = 0.15 x (45)m												

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	24.9283	21.8025	22.4982	19.6145	18.8206	16.2407	15.0494	17.2694	17.4757	20.3662	22.2313	24.1418 (46)
Water storage loss:												
Store volume												190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3166 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7110 (55)
Total storage loss												
	22.0401	19.9072	22.0401	21.3291	22.0401	21.3291	22.0401	22.0401	21.3291	22.0401	21.3291	22.0401 (56)
If cylinder contains dedicated solar storage												
	13.3401	12.0491	13.3401	12.9097	13.3401	12.9097	13.3401	13.3401	12.9097	13.3401	12.9097	13.3401 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	202.7914	178.4102	185.1948	159.4314	149.2786	131.0865	123.9049	139.6355	146.5234	170.9815	183.6305	197.5476 (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												1200.5924 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2016.9953 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2583 (H8)
Utilisation factor												0.5483 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												109.5000 (H13)
Daily hot water demand												101.8772 (H14)
Volume ratio Veff/V												1.0748 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-972.4045 (H17)
Solar input	-31.9219	-45.3909	-78.0161	-105.2617	-123.0242	-132.6422	-126.2650	-115.0823	-89.9255	-61.8425	-37.7552	-25.2769 (63)
								Solar input (sum of months) = Sum(63)m =				-972.4045 (63)
Output from w/h												
	170.8695	133.0193	107.1788	54.1697	26.2544	0.0000	0.0000	24.5532	56.5979	109.1390	145.8753	172.2707 (64)
								Total per year (kWh/year) = Sum(64)m =				999.9277 (64)
Heat gains from water heating, kWh/month												
	84.5398	74.7771	78.0364	66.4133	60.7654	54.2523	52.2199	57.8854	62.7528	73.3105	77.6168	82.7962 (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	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739	170.9739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	63.7665	56.6368	46.0601	34.8705	26.0661	22.0061	23.7784	30.9080	41.4847	52.6743	61.4787	65.5387 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	419.1630	423.5126	412.5517	389.2174	359.7619	332.0780	313.5834	309.2338	320.1946	343.5290	372.9844	400.6684 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470	54.9470 (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)	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826	-113.9826 (71)
Water heating gains (Table 5)	113.6288	111.2754	104.8876	92.2407	81.6740	75.3504	70.1881	77.8029	87.1567	98.5356	107.8011	111.2852 (72)
Total internal gains	711.4964	706.3630	678.4378	631.2668	582.4402	544.3727	522.4881	532.8830	563.7743	609.6772	657.2025	692.4306 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	0.9600	14.6176	0.6300	0.7000	0.7700	4.2887 (75)
East	0.8700	25.1925	0.6300	0.7000	0.7700	6.6983 (76)
Southeast	5.8800	45.1778	0.6300	0.7000	0.7700	81.1848 (77)
South	1.7300	56.7559	0.6300	0.7000	0.7700	30.0074 (78)
Southwest	2.9300	45.1778	0.6300	0.7000	0.7700	40.4543 (79)
West	0.8700	25.1925	0.6300	0.7000	0.7700	6.6983 (80)
Northwest	8.1100	14.6176	0.6300	0.7000	0.7700	36.2302 (81)

Solar gains	205.5618	310.9263	462.8436	632.9747	717.4402	803.0365	738.0997	669.2847	545.1904	375.8118	248.1849	164.8169 (83)
Total gains	917.0583	1017.2893	1141.2814	1264.2415	1299.8804	1347.4092	1260.5878	1202.1677	1108.9647	985.4890	905.3875	857.2475 (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	18.1829	18.3254	18.3254	18.4160	18.4160	18.5029	18.5029	18.5859	18.5859	18.4599	18.5029	18.4160
alpha	2.2122	2.2217	2.2217	2.2277	2.2277	2.2335	2.2335	2.2391	2.2391	2.2307	2.2335	2.2277
util living area												
	0.9171	0.8951	0.8479	0.7672	0.6472	0.4731	0.3513	0.3645	0.5836	0.7812	0.8827	0.9250 (86)
MIT	18.6108	18.8658	19.3681	19.9593	20.4907	20.8318	20.9412	20.9371	20.7098	20.1136	19.3052	18.5892 (87)
Th 2	19.8688	19.8766	19.8766	19.8815	19.8815	19.8861	19.8861	19.8905	19.8905	19.8838	19.8861	19.8815 (88)
util rest of house												
	0.9058	0.8810	0.8268	0.7337	0.5916	0.3894	0.2427	0.2531	0.5039	0.7407	0.8641	0.9145 (89)
MIT 2	17.7355	17.9888	18.4752	19.0390	19.5212	19.7982	19.8680	19.8709	19.7191	19.1988	18.4298	17.7241 (90)
Living area fraction												
									fLA = Living area / (4) = 0.1875 (91)			

MIT	17.8996	18.1532	18.6426	19.2116	19.7030	19.9920	20.0692	20.0708	19.9048	19.3703	18.5940	17.8863 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8996	18.1532	18.6426	19.2116	19.7030	19.9920	20.0692	20.0708	19.9048	19.3703	18.5940	17.8863 (93)

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4378.5363	0.2160	945.7638 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1146.0783	0.2160	247.5529 (264)

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Space and water heating			1193.3167 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	450.4543	0.5190	233.7858 (268)
Energy saving/generation technologies			
PV Unit	-993.0186	0.5190	-515.3766 (269)
Total kg/year			976.6009 (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	4378.5363	1.2200	5341.8143 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1146.0783	1.2200	1398.2155 (264)
Space and water heating			6740.0298 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	450.4543	3.0700	1382.8946 (268)
Energy saving/generation technologies			
PV Unit	-993.0186	3.0700	-3048.5670 (269)
Primary energy kWh/year			5458.1074 (272)
Primary energy kWh/m2/year			46.7744 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	82.8 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	778.57 (P1)
Transmission heat loss coefficient	90.17 (37)
Summer heat loss coefficient	868.74 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.9600	106.0502	0.6300	0.7000	0.9000	36.3669
East	0.8700	125.2818	0.6300	0.7000	0.9000	38.9342
South East	5.8800	127.3119	0.6300	0.7000	0.9000	267.4052
South	1.7300	118.5567	0.6300	0.7000	0.9000	73.2649
South West	2.9300	127.3119	0.6300	0.7000	0.9000	133.2478
West	0.8700	125.2818	0.6300	0.7000	0.9000	38.9342
North West	8.1100	106.0502	0.6300	0.7000	0.9000	307.2246
total:						895.3777

Solar gains	Jun 963	Jul 895	Aug 795	(P3)
Internal gains	564	542	551	
Total summer gains	1527	1437	1346	(P5)
Summer gain/loss ratio	1.76	1.65	1.55	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 82.8)	1.42	1.42	1.42	

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Threshold temperature	18.58	20.38	20.27	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			