



elmhurst  
energy



## SAP Report Submission for Building Regulations Compliance

Client: Shorewood Homes Ltd

Project: Tree House, Larg Drive  
Winchester, Hampshire, SO22 6NU

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Report Issue Date: 01/03/2023

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

<b>Property Reference</b>	SAP-1425 - Plot 1	<b>Issued on Date</b>	01/03/2023	
<b>Assessment Reference</b>	REV-	<b>Prop Type Ref</b>		
<b>Property</b>	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU			
<b>SAP Rating</b>	92 A	<b>DER</b>	10.85	
<b>Environmental</b>	91 B	<b>TER</b>	17.91	
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.85	<b>% DER&lt;TER</b>	39.43	
<b>General Requirements Compliance</b>	Pass	<b>DFEE</b>	55.48	
		<b>TFEE</b>	63.49	
		<b>% DFEE&lt;TFEE</b>	12.63	
<b>Assessor Details</b>	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk		<b>Assessor ID</b>	p775-0001
<b>Client</b>	Shorewood Homes Ltd, SHOREWOOD HOMES			

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

#### Criterion 1 – Achieving the TER and TFEE rate

##### 1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.91	kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling Carbon Dioxide Emission Rate (DER)	10.85	kgCO <sub>2</sub> /m <sup>2</sup>	Pass
	-7.06 (-39.4%)	kgCO <sub>2</sub> /m <sup>2</sup>	

##### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.49	kWh/m <sup>2</sup> /yr	
Dwelling Fabric Energy Efficiency (DFEE)	55.48	kWh/m <sup>2</sup> /yr	
	-8.0 (-12.6%)	kWh/m <sup>2</sup> /yr	Pass

#### Criterion 2 – Limits on design flexibility

##### Limiting Fabric Standards

##### 2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.15 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

##### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

##### 3 Air permeability

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

##### Limiting System Efficiencies

##### 4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 18i System ErP  Efficiency: 89.7% SEDBUK2009 Minimum: 88.0%	Pass
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# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.95 kWh/day  
Permitted by DBSCG 2.30

Pass

Primary pipework insulated

Yes

Pass

### 6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

Boiler interlock

Yes

Pass

### 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

1.34 m<sup>2</sup>, No overhang

Windows facing South East

8.74 m<sup>2</sup>, No overhang

Windows facing South West

1.34 m<sup>2</sup>, No overhang

Windows facing North West

10.38 m<sup>2</sup>, No overhang

Air change rate

8.00 ach

Blinds/curtains

None

## Criterion 4 – Building performance consistent with DER and DFEE rate

### Air permeability and pressure testing

#### 3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

Maximum

10.0

Pass

### 10 Key features

Roof U-value

0.10

W/m<sup>2</sup>K

Floor U-value

0.12

W/m<sup>2</sup>K

Photovoltaic array

2.30

kW

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

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Property Reference	SAP-1425 - Plot 1		Issued on Date	01/03/2023	
Assessment Reference	REV-	Prop Type Ref			
Property	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU				
SAP Rating	92 A	DER	10.85	TER	17.91
Environmental	91 B	% DER<TER	39.43		
CO <sub>2</sub> Emissions (t/year)	0.85	DFEE	55.48	TFEE	63.49
General Requirements Compliance	Pass	% DFEE<TFEE	12.63		
Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk			Assessor ID	p775-0001
Client	Shorewood Homes Ltd, SHOREWOOD HOMES				

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

Orientation	North West
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
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:	38.59 m	66.18 m <sup>2</sup>	2.47 m
1st Storey:	32.28 m	58.28 m <sup>2</sup>	2.73 m

7.0 Living Area  m<sup>2</sup>

8.0 Thermal Mass Parameter  
 Thermal Mass   
 kJ/m<sup>2</sup>K

#### 9.0 External Walls

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area (m <sup>2</sup> )	Nett Area (m <sup>2</sup> )
External Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.18	60.00	185.11	160.98

#### 9.2 Internal Walls

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Wall - Masonry	Dense block, plasterboard on dabs	75.00	39.59
Internal Wall on timber frame	Plasterboard on timber frame	9.00	125.16

#### 10.0 External Roofs

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area (m <sup>2</sup> )	Nett Area (m <sup>2</sup> )
Bay Roof	External Flat Roof	Plasterboard, insulated flat roof	0.15	9.00	2.31	2.31
Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	5.52	3.72
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	58.28	58.28

#### 10.2 Internal Ceilings

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	58.28

### 11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Ground Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	66.18

### 11.2 Internal Floors

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	58.28

### 12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
Front Door	Manufacturer	Solid Door							1.40
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Lantern Rooflight	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.40

### 13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m <sup>2</sup> )	Curtain Closed
Front Door	Solid Door	[1] External Walls	North West							2.33	
Front Elevation	Window	[1] External Walls	North West	None	0.00					10.38	
Side Elevation	Window	[1] External Walls	North East	None	0.00					1.34	
Rear Elevation	Window	[1] External Walls	South East	None	0.00					8.74	
Side Elevation	Window	[1] External Walls	South West	None	0.00					1.34	
Lantern Rooflight	Roof Window	[2] Flat Roof	North	None						1.80	

### 14.0 Conservatory

### 15.0 Draught Proofing

 %

### 16.0 Draught Lobby

### 17.0 Thermal Bridging

### 17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	14.03	0.300	No
Table K1 - Approved	E3 Sill	13.03	0.040	No
Table K1 - Approved	E4 Jamb	37.05	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	38.59	0.160	Yes
Table K1 - Approved	E6 Intermediate floor within a dwelling	32.28	0.070	Yes
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	32.28	0.060	No
Table K1 - Default	E24 Eaves (insulation at ceiling level - inverted)	10.83	0.240	No
Table K1 - Default	E14 Flat roof	4.30	0.080	No
Table K1 - Default	E15 Flat roof with parapet	6.78	0.560	No
Table K1 - Approved	E16 Corner (normal)	33.51	0.090	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	12.50	-0.090	No

Y-value  W/m<sup>2</sup>K

### 18.0 Pressure Testing

Designed AP<sub>50</sub>  m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

Property Tested ?

As Built AP<sub>50</sub>  m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

### 19.0 Mechanical Ventilation

#### Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	8.00

#### Mechanical Ventilation

Mechanical Ventilation System Present	No
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### 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

No

### 22.0 Lighting

#### Internal

Total number of light fittings	50	
Total number of L.E.L. fittings	50	
Percentage of L.E.L. fittings	100.00	%

#### External

External lights fitted	No
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### 23.0 Electricity Tariff

Standard

### 24.0 Main Heating 1

Percentage of Heat	100	%
Database Ref. No.	17485	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.7	
In Summer	80.0	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators and Underfloor	
Underfloor Heating	Yes - Pipes in thin screed	
Flow Temperature	Unknown	

### 25.0 Main Heating 2

None

Community Heating	None
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# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

<b>28.0 Water Heating</b>	HWP From main heating 1			
Water Heating	Main Heating 1			
Flue Gas Heat Recovery System	No			
Waste Water Heat Recovery Instantaneous System 1	No			
Waste Water Heat Recovery Instantaneous System 2	No			
Waste Water Heat Recovery Storage System	No			
Solar Panel	No			
Water use <= 125 litres/person/day	Yes			
SAP Code	901			
<b>29.0 Hot Water Cylinder</b>	Hot Water Cylinder			
Cylinder Stat	Yes			
Cylinder In Heated Space	Yes			
Independent Time Control	Yes			
Insulation Type	Measured Loss			
Cylinder Volume	210.00			L
Loss	1.95			kWh/day
Pipes insulation	Fully insulated primary pipework			
<b>31.0 Thermal Store</b>	None			
<b>32.0 Photovoltaic Unit</b>	One Dwelling			
<b>PV Cells kWp</b>	<b>Orientation</b>	<b>Elevation</b>	<b>Overshading</b>	<b>Connected to Dwelling</b>
2.30	South West	30°	None Or Little	Yes

### Recommendations

#### Lower cost measures

None

#### Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£115	A 93	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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<b>Property</b>	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU				
<b>SAP Rating</b>	92 A	<b>DER</b>	10.85	<b>TER</b>	17.91
<b>Environmental</b>	91 B	<b>% DER&lt;TER</b>	39.43		
<b>CO<sub>2</sub> Emissions (t/year)</b>	0.85	<b>DFEE</b>	55.48	<b>TFEE</b>	63.49
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	12.63		
<b>Assessor Details</b>	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk			<b>Assessor ID</b>	p775-0001
<b>Client</b>	Shorewood Homes Ltd, SHOREWOOD HOMES				



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### DWELLING AS DESIGNED

Detached House, total floor area 124 m<sup>2</sup>

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) 17.91 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.85 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)55.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

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

#### 4 Heating efficiency

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

Data from database  
Worcester Greenstar 18i System ErP

Efficiency: 89.7% SEDBUK2009  
Minimum: 88.0% OK

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.95 kWh/day  
Permitted by DBSCG 2.30 OK  
Primary pipework insulated: Yes OK

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK  
Independent timer for DHW OK

Boiler interlock Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Southern England): Not significant OK

Based on:

Overshading: Average  
Windows facing North East: 1.34 m<sup>2</sup>, No overhang  
Windows facing South East: 8.74 m<sup>2</sup>, No overhang  
Windows facing South West: 1.34 m<sup>2</sup>, No overhang  
Windows facing North West: 10.38 m<sup>2</sup>, No overhang  
Air change rate: 8.00 ach  
Blinds/curtains: None

#### 10 Key features

Roof U-value 0.10 W/m<sup>2</sup>K  
Floor U-value 0.12 W/m<sup>2</sup>K  
Photovoltaic array 2.30 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3740 (18)
Number of sides sheltered				0	0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Heat transfer coeff	169.0741	168.6042	168.1435	165.9798	165.5750	163.6905	163.6905	163.3415	164.4164	165.5750	166.3939	167.2501 (39)
Average = Sum(39)m / 12 =												165.9779 (39)
HLP	1.3585	1.3547	1.3510	1.3336	1.3303	1.3152	1.3152	1.3124	1.3210	1.3303	1.3369	1.3438 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
Heat gains from water heating, kWh/month	100.3616	89.0569	94.9378	87.0590	86.7297	79.5291	78.3129	83.2678	82.2854	90.1795	92.8994	98.6061 (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	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2323	23.2993	18.9483	14.3450	10.7231	9.0529	9.7820	12.7150	17.0660	21.6692	25.2912	26.9614 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.9113	293.9300	286.3229	270.1282	249.6852	230.4718	217.6360	214.6172	222.2244	238.4191	258.8620	278.0755 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951 (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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)	134.8946	132.5251	127.6046	120.9152	116.5722	110.4571	105.2593	111.9190	114.2852	121.2089	129.0270	132.5350 (72)
Total internal gains	521.2235	518.9398	502.0611	474.5738	446.1659	419.1670	401.8626	408.4366	422.7609	450.4826	482.3655	506.7572 (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	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206 (75)						
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	10.3800	11.2829	0.6300	0.7000	0.7700	35.7925 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070 (83)
Total gains	693.5578	832.8511	983.0230	1152.4566	1277.1381	1274.8320	1214.0995	1102.3176	971.5531	811.5492	692.5542	651.7642 (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	35.1504	35.2483	35.3449	35.8057	35.8932	36.3064	36.3064	36.3840	36.1461	35.8932	35.7165	35.5337
alpha	3.3434	3.3499	3.3563	3.3870	3.3929	3.4204	3.4204	3.4256	3.4097	3.3929	3.3811	3.3689
util living area	0.9931	0.9867	0.9711	0.9288	0.8386	0.6928	0.5483	0.6101	0.8291	0.9572	0.9881	0.9944 (86)
MIT	19.3920	19.5641	19.8565	20.2455	20.5829	20.8023	20.8817	20.8643	20.6835	20.2399	19.7492	19.3681 (87)
Th 2	19.7953	19.7982	19.8011	19.8146	19.8171	19.8289	19.8289	19.8311	19.8244	19.8171	19.8120	19.8067 (88)
util rest of house	0.9913	0.9833	0.9635	0.9088	0.7916	0.6032	0.4207	0.4825	0.7608	0.9414	0.9845	0.9930 (89)
MIT 2	17.6523	17.9048	18.3300	18.8926	19.3495	19.6214	19.6946	19.6855	19.4950	18.8969	18.1856	17.6254 (90)
Living area fraction										fLA = Living area / (4) =		0.1243 (91)
MIT	17.8686	18.1110	18.5197	19.0607	19.5028	19.7682	19.8421	19.8320	19.6427	19.0638	18.3800	17.8420 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8686	18.1110	18.5197	19.0607	19.5028	19.7682	19.8421	19.8320	19.6427	19.0638	18.3800	17.8420 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	684.6416	813.2596	936.0500	1028.6691	992.0717	762.3368	512.6233	531.9845	726.6011	752.6838	677.3472	644.8997 (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	2294.0924	2227.4303	2021.0362	1686.4748	1291.9552	845.9843	530.7083	560.5944	911.3123	1401.3942	1876.9206	2281.6292 (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 Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating	1197.4314	950.3227	807.2297	473.6201	223.1133	0.0000	0.0000	0.0000	0.0000	482.6405	863.6928	1217.7268 (98)
Space heating per m2												(98) / (4) = 49.9420 (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 %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												6853.1172 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1197.4314	950.3227	807.2297	473.6201	223.1133	0.0000	0.0000	0.0000	0.0000	482.6405	863.6928	1217.7268 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1320.2110	1047.7648	889.9997	522.1831	245.9904	0.0000	0.0000	0.0000	0.0000	532.1285	952.2523	1342.5874 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
Efficiency of water heater (217)m	88.8330	88.6651	88.2906	87.4065	85.5554	80.0000	80.0000	80.0000	80.0000	87.3668	88.4458	80.0000 (216)
Fuel for water heating, kWh/month	251.2980	222.0076	234.3665	212.5280	213.0051	203.8962	196.1548	214.7819	214.2582	220.4642	229.8906	245.1834 (219)
Water heating fuel used												2657.8346 (219)
Annual totals kWh/year												6853.1172 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
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)												463.2704 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.30 * 1029 * 1.00) =												-1893.7036
Total delivered energy for all uses												8155.5187 (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	6853.1172	0.2160	1480.2733 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2657.8346	0.2160	574.0923 (264)
Space and water heating			2054.3656 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Energy saving/generation technologies			
PV Unit	-1893.7036	0.5190	-982.8321 (269)
Total CO2, kg/year			1350.8958 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.8500 (273)

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

DER		10.8500 ZC1
Total Floor Area	TFA	124.4600
Assumed number of occupants	N	2.8790
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		13.8509 ZC2
CO2 emissions from cooking, equation (L16)		1.5113 ZC3
Total CO2 emissions		26.2122 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		26.2122 ZC8

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3740	(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) =		0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (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			2.3300	1.0000	2.3300		(26)
TER Opening Type (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652		(27a)
Ground Floor			66.1800	0.1300	8.6034		(28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764		(29a)
Bay Roof	2.3100		2.3100	0.1300	0.3003		(30)
Flat Roof	5.5200	1.8000	3.7200	0.1300	0.4836		(30)
Pitched Cold Roof	58.2800		58.2800	0.1300	7.5764		(30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =		80.0368 (33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							19.9476 (36)
Total fabric heat loss							(33) + (36) = 99.9844 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Average = Sum(39)m / 12 =	165.3109	164.8410	164.3803	162.2166	161.8118	159.9273	159.9273	159.5783	160.6532	161.8118	162.6307	163.4869 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3282	1.3244	1.3207	1.3034	1.3001	1.2850	1.2850	1.2822	1.2908	1.3001	1.3067	1.3136 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)
Energy conte	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Energy content (annual)												Total = Sum(45)m = 1613.9319 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)
Water storage loss:												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Store volume														210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):														1.7016 (48)
Temperature factor from Table 2b														0.5400 (49)
Enter (49) or (54) in (55)														0.9188 (55)
Total storage loss														
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	27.5653	(56)
If cylinder contains dedicated solar storage														
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	27.5653	(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	22.5120	(59)
Total heat required for water heating calculated for each month														
	219.0768	193.0869	202.7647	181.7386	178.0787	159.0923	152.7650	167.6667	167.3819	188.4537	199.3039	213.7970	213.7970	(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	0.0000	(63)
Solar input (sum of months) = Sum(63)m =														0.0000 (63)
Output from w/h														
	219.0768	193.0869	202.7647	181.7386	178.0787	159.0923	152.7650	167.6667	167.3819	188.4537	199.3039	213.7970	213.7970	(64)
Total per year (kWh/year) = Sum(64)m =														2223.2063 (64)
Heat gains from water heating, kWh/month														
	97.0346	86.0518	91.6108	83.8392	83.4027	76.3094	74.9859	79.9407	79.0656	86.8524	89.6797	95.2790	95.2790	(65)

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

Metabolic gains (Table 5), Watts														
(66)m	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5														
	26.2323	23.2993	18.9483	14.3450	10.7231	9.0529	9.7820	12.7150	17.0660	21.6692	25.2912	26.9614	26.9614	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5														
	290.9113	293.9300	286.3229	270.1282	249.6852	230.4718	217.6360	214.6172	222.2244	238.4191	258.8620	278.0755	278.0755	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5														
	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)														
	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	(71)
Water heating gains (Table 5)														
	130.4228	128.0533	123.1328	116.4434	112.1004	105.9852	100.7875	107.4472	109.8134	116.7371	124.5551	128.0632	128.0632	(72)
Total internal gains														
	516.7517	514.4679	497.5892	470.1019	441.6940	414.6952	397.3908	403.9647	418.2891	446.0107	477.8937	502.2854	502.2854	(73)

#### 6. Solar gains

[Jan]														
		Area	Solar flux	Specific data	Specific data	FF	Access	Gains						
		m2	Table 6a	g	Specific data		factor	W						
			W/m2	or Table 6b	or Table 6c		Table 6d							
Northeast		1.3400	11.2829	0.6300	0.7000	0.7700	4.6206						(75)	
Southeast		8.7400	36.7938	0.6300	0.7000	0.7700	98.2784						(77)	
Southwest		1.3400	36.7938	0.6300	0.7000	0.7700	15.0679						(79)	
Northwest		10.3800	11.2829	0.6300	0.7000	0.7700	35.7925						(81)	
North		1.8000	26.0000	0.6300	0.7000	1.0000	18.5749						(82)	
Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070	145.0070	(83)
Total gains	689.0860	828.3793	978.5512	1147.9848	1272.6663	1270.3602	1209.6276	1097.8458	967.0813	807.0774	688.0824	647.2924	647.2924	(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	52.2836	52.4327	52.5796	53.2809	53.4142	54.0436	54.0436	54.1618	53.7995	53.4142	53.1453	52.8670		
alpha	4.4856	4.4955	4.5053	4.5521	4.5609	4.6029	4.6029	4.6108	4.5866	4.5609	4.5430	4.5245		
util living area	0.9985	0.9963	0.9892	0.9619	0.8815	0.7232	0.5606	0.6300	0.8721	0.9815	0.9969	0.9989		(86)
MIT	19.4852	19.6627	19.9641	20.3698	20.7187	20.9228	20.9812	20.9687	20.8050	20.3458	19.8448	19.4612		(87)
Th 2	19.8188	19.8217	19.8246	19.8382	19.8407	19.8526	19.8526	19.8548	19.8480	19.8407	19.8356	19.8302		(88)
util rest of house	0.9980	0.9950	0.9852	0.9466	0.8340	0.6242	0.4250	0.4915	0.8015	0.9714	0.9955	0.9985		(89)
MIT 2	17.8088	18.0699	18.5102	19.0988	19.5655	19.8019	19.8460	19.8422	19.6883	19.0756	18.3461	17.7814		(90)
Living area fraction									fLA =	Living area / (4) =				(91)
MIT	18.0171	18.2678	18.6909	19.2568	19.7088	19.9412	19.9871	19.9822	19.8271	19.2335	18.5324	17.9902		(92)
Temperature adjustment												0.0000		
adjusted MIT	18.0171	18.2678	18.6909	19.2568	19.7088	19.9412	19.9871	19.9822	19.8271	19.2335	18.5324	17.9902		(93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Useful gains	0.9967	0.9923	0.9793	0.9364	0.8275	0.6327	0.4416	0.5081	0.8000	0.9637	0.9931	0.9975		(94)
Ext temp.	686.7886	821.9916	958.3419	1074.9373	1053.1573	803.7115	534.1946	557.7683	773.6226	777.7837	683.3239	645.6611		(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	2267.5934	2203.5691	2003.9471	1680.0462	1295.9237	854.2067	541.6887	571.6446	920.0703	1396.9984	1859.2523	2254.5177		(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 per m2	1176.1188	928.4201	777.9302	435.6784	180.6182	0.0000	0.0000	0.0000	0.0000	460.6958	846.6685	1196.9893		(98)
												6003.1193		(98)
												(98) / (4) =		48.2333 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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													6420.4484 (211)
Space heating requirement	1176.1188	928.4201	777.9302	435.6784	180.6182	0.0000	0.0000	0.0000	0.0000	460.6958	846.6685	1196.9893	(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)	1257.8810	992.9627	832.0110	465.9662	193.1746	0.0000	0.0000	0.0000	0.0000	492.7228	905.5278	1280.2024	(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	219.0768	193.0869	202.7647	181.7386	178.0787	159.0923	152.7650	167.6667	167.3819	188.4537	199.3039	213.7970	(64)
Efficiency of water heater (217)m	88.6339	88.4579	88.0588	87.0637	84.8516	79.8000	79.8000	79.8000	79.8000	87.1092	88.2454	88.6977	(217)
Fuel for water heating, kWh/month	247.1705	218.2811	230.2607	208.7420	209.8707	199.3638	191.4348	210.1086	209.7518	216.3420	225.8519	241.0401	(219)
Water heating fuel used													2608.2181 (219)
Annual totals kWh/year													
Space heating fuel - main system													6420.4484 (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)													463.2704 (232)
Total delivered energy for all uses													9566.9370 (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	6420.4484	0.2160	1386.8169 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2608.2181	0.2160	563.3751 (264)
Space and water heating			1950.1920 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Total CO2, kg/m2/year			2229.5543 (272)
Emissions per m2 for space and water heating			15.6692 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.9318 (272b)
Emissions per m2 for pumps and fans			0.3128 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6692 * 1.00) + 1.9318 + 0.3128, rounded to 2 d.p.			17.9100 (273)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3740	0.3740 (18)
Number of sides sheltered				0	0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			9.0000	524.5200 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 20870.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							167.6871 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss							(33) + (36) = 103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Heat transfer coeff	169.0741	168.6042	168.1435	165.9798	165.5750	163.6905	163.6905	163.3415	164.4164	165.5750	166.3939	167.2501 (39)
Average = Sum(39)m / 12 =												165.9779 (39)
HLP	1.3585	1.3547	1.3510	1.3336	1.3303	1.3152	1.3152	1.3124	1.3210	1.3303	1.3369	1.3438 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Energy content (annual)												Total = Sum(45)m = 1613.9319 (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												
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	35.5577	31.0990	32.0913	27.9780	26.8456	23.1657	21.4664	24.6330	24.9272	29.0503	31.7106	34.4357 (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	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2323	23.2993	18.9483	14.3450	10.7231	9.0529	9.7820	12.7150	17.0660	21.6692	25.2912	26.9614 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.9113	293.9300	286.3229	270.1282	249.6852	230.4718	217.6360	214.6172	222.2244	238.4191	258.8620	278.0755 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951 (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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)	47.7926	46.2782	43.1335	38.8584	36.0828	32.1746	28.8527	33.1089	34.6211	39.0461	44.0426	46.2845 (72)
Total internal gains	431.1215	429.6929	414.5900	389.5169	362.6764	337.8845	322.4560	326.6264	340.0969	365.3197	394.3811	417.5068 (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	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206 (75)
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784 (77)
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)
Northwest	10.3800	11.2829	0.6300	0.7000	0.7700	35.7925 (81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)

Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070 (83)
Total gains	603.4558	743.6042	895.5519	1067.3997	1193.6486	1193.5495	1134.6928	1020.5075	888.8890	726.3863	604.5698	562.5137 (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	34.2886	34.3842	34.4784	34.9278	35.0132	35.4163	35.4163	35.4920	35.2600	35.0132	34.8409	34.6626
alpha	3.2859	3.2923	3.2986	3.3285	3.3342	3.3611	3.3611	3.3661	3.3507	3.3342	3.3227	3.3108
util living area	0.9951	0.9897	0.9764	0.9389	0.8561	0.7181	0.5764	0.6423	0.8538	0.9667	0.9914	0.9961 (86)
MIT	18.8430	19.0785	19.4801	20.0180	20.4941	20.8133	20.9351	20.9059	20.6324	20.0039	19.3290	18.8098 (87)
Th 2	19.7953	19.7982	19.8011	19.8146	19.8171	19.8289	19.8289	19.8311	19.8244	19.8171	19.8120	19.8067 (88)
util rest of house	0.9938	0.9871	0.9701	0.9214	0.8126	0.6304	0.4460	0.5137	0.7917	0.9541	0.9888	0.9951 (89)
MIT 2	17.8352	18.0716	18.4717	19.0064	19.4518	19.7275	19.8069	19.7956	19.5919	19.0034	18.3322	17.8103 (90)
Living area fraction	fLA = Living area / (4) = 0.1243 (91)											
MIT	17.9604	18.1968	18.5970	19.1321	19.5814	19.8625	19.9472	19.9336	19.7212	19.1278	18.4561	17.9345 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.9604	18.1968	18.5970	19.1321	19.5814	19.8625	19.9472	19.9336	19.7212	19.1278	18.4561	17.9345 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9910	0.9822	0.9615	0.9086	0.8023	0.6333	0.4603	0.5262	0.7849	0.9439	0.9845	0.9928 (94)
Ext temp.	598.0212	730.3533	861.0493	969.8110	957.6780	755.8509	522.3031	537.0260	697.7120	685.6472	595.1798	558.4765 (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	2309.6269	2241.8954	2034.0400	1698.3295	1304.9623	861.4185	547.8973	577.1816	924.2247	1411.9871	1889.5893	2297.0981 (97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating per m2	1273.4346	1015.7563	872.7051	524.5333	258.3796	0.0000	0.0000	0.0000	0.0000	540.3969	931.9748	1293.5345 (98)
												6710.7149 (98)
												(98) / (4) = 53.9186 (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
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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1538.6908	1211.3097	1241.3956	0.0000	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7575	0.8271	0.7856	0.0000	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1165.5590	1001.9260	975.1816	0.0000	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1487.5327	1417.4423	1290.0472	0.0000	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	231.8211	309.1441	234.2600	0.0000	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction													775.2252 (104)
Intermittency factor (Table 10b)													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	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	57.9553	77.2860	58.5650	0.0000	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling													193.8063 (107)
Space cooling per m2													1.5572 (108)
Energy for space heating													53.9186 (99)
Energy for space cooling													1.5572 (108)
Total													55.4758 (109)
Dwelling Fabric Energy Efficiency (DFEE)													55.5 (109)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3740 (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) =	0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (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			2.3300	1.0000	2.3300		(26)
TER Opening Type (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652		(27a)
Ground Floor			66.1800	0.1300	8.6034		(28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764		(29a)
Bay Roof			2.3100	0.1300	0.3003		(30)
Flat Roof		1.8000	3.7200	0.1300	0.4836		(30)
Pitched Cold Roof			58.2800	0.1300	7.5764		(30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	80.0368	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)  
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.9476 (36)  
 Total fabric heat loss (33) + (36) = 99.9844 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Heat transfer coeff												
Average = Sum(39)m / 12 =	165.3109	164.8410	164.3803	162.2166	161.8118	159.9273	159.9273	159.5783	160.6532	161.8118	162.6307	163.4869 (39)
												162.2147 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3282	1.3244	1.3207	1.3034	1.3001	1.2850	1.2850	1.2822	1.2908	1.3001	1.3067	1.3136 (40)
HLP (average)												1.3033 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)
Energy conte	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Energy content (annual)												Total = Sum(45)m = 1613.9319 (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:												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	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	0.0000	(59)
Heat gains from water heating, kWh/month	35.5577	31.0990	32.0913	27.9780	26.8456	23.1657	21.4664	24.6330	24.9272	29.0503	31.7106	34.4357	34.4357	(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	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	143.9511	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2323	23.2993	18.9483	14.3450	10.7231	9.0529	9.7820	12.7150	17.0660	21.6692	25.2912	26.9614	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.9113	293.9300	286.3229	270.1282	249.6852	230.4718	217.6360	214.6172	222.2244	238.4191	258.8620	278.0755	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	37.3951	(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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	(71)
Water heating gains (Table 5)	47.7926	46.2782	43.1335	38.8584	36.0828	32.1746	28.8527	33.1089	34.6211	39.0461	44.0426	46.2845	(72)
Total internal gains	431.1215	429.6929	414.5900	389.5169	362.6764	337.8845	322.4560	326.6264	340.0969	365.3197	394.3811	417.5068	(73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206 (75)
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784 (77)
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)
Northwest	10.3800	11.2829	0.6300	0.7000	0.7700	35.7925 (81)
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)

Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070	(83)
Total gains	603.4558	743.6042	895.5519	1067.3997	1193.6486	1193.5495	1134.6928	1020.5075	888.8890	726.3863	604.5698	562.5137	(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	52.2836	52.4327	52.5796	53.2809	53.4142	54.0436	54.0436	54.1618	53.7995	53.4142	53.1453	52.8670		
alpha	4.4856	4.4955	4.5053	4.5521	4.5609	4.6029	4.6029	4.6108	4.5866	4.5609	4.5430	4.5245		
util living area	0.9991	0.9976	0.9924	0.9705	0.9007	0.7532	0.5921	0.6668	0.8985	0.9876	0.9982	0.9994	(86)	
MIT	19.4230	19.6016	19.9061	20.3196	20.6844	20.9083	20.9766	20.9606	20.7720	20.2908	19.7843	19.3994	(87)	
Th 2	19.8188	19.8217	19.8246	19.8382	19.8407	19.8526	19.8526	19.8548	19.8480	19.8407	19.8356	19.8302	(88)	
util rest of house	0.9988	0.9968	0.9894	0.9581	0.8581	0.6557	0.4515	0.5252	0.8363	0.9805	0.9974	0.9992	(89)	
MIT 2	18.3843	18.5649	18.8701	19.2864	19.6255	19.8103	19.8468	19.8436	19.7156	19.2656	18.7584	18.3696	(90)	
Living area fraction										fLA = Living area / (4) =		0.1243	(91)	
MIT	18.5134	18.6938	18.9989	19.4148	19.7571	19.9468	19.9872	19.9824	19.8469	19.3931	18.8859	18.4976	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.5134	18.6938	18.9989	19.4148	19.7571	19.9468	19.9872	19.9824	19.8469	19.3931	18.8859	18.4976	(93)	

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9983	0.9956	0.9865	0.9522	0.8544	0.6647	0.4690	0.5425	0.8362	0.9766	0.9964	0.9988	(94)
Useful gains	602.4467	740.3072	883.4398	1016.3247	1019.8103	793.3157	532.1450	553.5930	743.2989	709.4181	602.3770	561.8348	(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	2349.6380	2273.7764	2054.5734	1705.6781	1303.7412	855.1006	541.7136	571.6720	923.2542	1422.8204	1916.7565	2337.4731	(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	1299.9103	1030.4913	871.3234	496.3344	211.2445	0.0000	0.0000	0.0000	0.0000	530.7712	946.3532	1321.0749	(98)
Space heating												6707.5034	(98)
Space heating per m <sup>2</sup>												(98) / (4) =	53.8928 (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	1503.3167	1183.4621	1212.7953	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8172	0.8869	0.8462	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1228.4480	1049.5950	1026.2277	0.0000	0.0000	0.0000	0.0000	(102)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1487.5327	1417.4423	1290.0472	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	186.5410	273.6784	196.2817	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												656.5011 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	46.6353	68.4196	49.0704	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												164.1253 (107)
Space cooling per m2												1.3187 (108)
Energy for space heating												53.8928 (99)
Energy for space cooling												1.3187 (108)
Total												55.2115 (109)
Target Fabric Energy Efficiency (TFEE)												63.5 (109)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3740 (18)
Number of sides sheltered				0	0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3740 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate	0.3834	0.3553	0.3647	0.3460	0.3366	0.3086	0.3086	0.2992	0.2992	0.3179	0.3086	0.3460 (22b)
Effective ac	0.5735	0.5631	0.5665	0.5598	0.5567	0.5476	0.5476	0.5448	0.5448	0.5505	0.5476	0.5598 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	61.0457	59.9429	60.3012	59.5939	59.2543	58.2911	58.2911	57.9886	57.9886	58.6028	58.2911	59.5939 (38)
Heat transfer coeff	164.7933	163.6905	164.0488	163.3415	163.0019	162.0387	162.0387	161.7362	161.7362	162.3504	162.0387	163.3415 (39)
Average = Sum(39)m / 12 =												162.8464 (39)
HLP	1.3241	1.3152	1.3181	1.3124	1.3097	1.3019	1.3019	1.2995	1.2995	1.3044	1.3019	1.3124 (40)
HLP (average)												1.3084 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
RHI water heating demand												2272 (64)
Heat gains from water heating, kWh/month	100.3616	89.0569	94.9378	87.0590	86.7297	79.5291	78.3129	83.2678	82.2854	90.1795	92.8994	98.6061 (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	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.5807	58.2482	47.3706	35.8626	26.8077	22.6322	24.4549	31.7874	42.6650	54.1730	63.2279	67.4034 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.1960	438.7015	427.3476	403.1764	372.6645	343.9877	324.8298	320.3242	331.6782	355.8494	386.3613	415.0381 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532 (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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)	134.8946	132.5251	127.6046	120.9152	116.5722	110.4571	105.2593	111.9190	114.2852	121.2089	129.0270	132.5350 (72)
Total internal gains	750.4049	745.2085	718.0564	675.6878	631.7781	592.8106	570.2777	579.7643	604.3620	646.9650	694.3497	730.7101 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Northeast	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882 (75)						
Southeast	8.7400	45.2918	0.6300	0.7000	0.7700	120.9769 (77)						
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)						
Northwest	10.3800	14.6223	0.6300	0.7000	0.7700	46.3859 (81)						
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)						
Solar gains	216.1892	336.3742	517.4219	735.0122	855.2123	958.3667	893.2483	782.5051	621.3735	412.9742	256.9657	172.0319 (83)
Total gains	966.5941	1081.5827	1235.4784	1410.7000	1486.9904	1551.1773	1463.5259	1362.2693	1225.7355	1059.9392	951.3154	902.7421 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	36.0635	36.3064	36.2271	36.3840	36.4598	36.6765	36.6765	36.7451	36.7451	36.6061	36.6765	36.3840
tau	3.4042	3.4204	3.4151	3.4256	3.4307	3.4451	3.4451	3.4497	3.4497	3.4404	3.4451	3.4256
util living area	0.9789	0.9676	0.9372	0.8651	0.7364	0.5349	0.3783	0.4245	0.6850	0.8939	0.9635	0.9827 (86)
MIT	19.7017	19.8557	20.1341	20.4690	20.7348	20.8772	20.9119	20.9072	20.8152	20.4906	20.0591	19.6729 (87)
Th 2	19.8220	19.8289	19.8267	19.8311	19.8333	19.8393	19.8393	19.8412	19.8412	19.8374	19.8393	19.8311 (88)
util rest of house	0.9738	0.9598	0.9215	0.8314	0.6715	0.4366	0.2572	0.2983	0.5910	0.8588	0.9529	0.9784 (89)
MIT 2	18.1202	18.3469	18.7417	19.2054	19.5440	19.6971	19.7218	19.7218	19.6473	19.2521	18.6503	18.0855 (90)
Living area fraction	18.3168	18.5345	18.9147	19.3624	19.6920	19.8438	19.8697	19.8691	19.7924	19.4061	18.8254	18.2828 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3168	18.5345	18.9147	19.3624	19.6920	19.8438	19.8697	19.8691	19.7924	19.4061	18.8254	18.2828 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	932.4949	1025.5272	1119.4108	1150.2420	985.3210	677.8110	381.1575	410.6890	718.9983	893.0147	894.6936	876.0471 (95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000 (96)
Heat loss rate W	2194.5169	2117.2505	1905.3831	1578.2770	1139.7095	703.8569	383.9849	415.5181	791.2856	1283.5527	1754.1317	2169.6289 (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)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating kWh	938.9444	733.6381	584.7634	308.1852	114.8651	0.0000	0.0000	0.0000	0.0000	290.5602	618.7954	962.4249 (98)
Space heating												4552.1766 (98)
RHI space heating demand												4552 (98)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3740	0.3740 (18)
Number of sides sheltered				0	0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Heat transfer coeff	169.0741	168.6042	168.1435	165.9798	165.5750	163.6905	163.6905	163.3415	164.4164	165.5750	166.3939	167.2501 (39)
Average = Sum(39)m / 12 =												165.9779 (39)
HLP	1.3585	1.3547	1.3510	1.3336	1.3303	1.3152	1.3152	1.3124	1.3210	1.3303	1.3369	1.3438 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
Heat gains from water heating, kWh/month	100.3616	89.0569	94.9378	87.0590	86.7297	79.5291	78.3129	83.2678	82.2854	90.1795	92.8994	98.6061 (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	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.5807	58.2482	47.3706	35.8626	26.8077	22.6322	24.4549	31.7874	42.6650	54.1730	63.2279	67.4034 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.1960	438.7015	427.3476	403.1764	372.6645	343.9877	324.8298	320.3242	331.6782	355.8494	386.3613	415.0381 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532 (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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)	134.8946	132.5251	127.6046	120.9152	116.5722	110.4571	105.2593	111.9190	114.2852	121.2089	129.0270	132.5350 (72)
Total internal gains	750.4049	745.2085	718.0564	675.6878	631.7781	592.8106	570.2777	579.7643	604.3620	646.9650	694.3497	730.7101 (73)

#### 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206 (75)						
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	10.3800	11.2829	0.6300	0.7000	0.7700	35.7925 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070 (83)
Total gains	922.7392	1059.1198	1199.0184	1353.5707	1462.7503	1448.4756	1382.5145	1273.6453	1153.1542	1008.0316	904.5384	875.7171 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	0.9839	0.9735	0.9508	0.8959	0.7918	0.6364	0.4925	0.5460	0.7669	0.9255	0.9741	0.9864 (86)
MIT	19.5487	19.7140	19.9894	20.3478	20.6457	20.8303	20.8927	20.8808	20.7404	20.3523	19.8908	19.5229 (87)
Th 2	19.7953	19.7982	19.8011	19.8146	19.8171	19.8289	19.8289	19.8311	19.8244	19.8171	19.8120	19.8067 (88)
util rest of house	0.9800	0.9672	0.9387	0.8694	0.7386	0.5466	0.3734	0.4248	0.6893	0.9008	0.9668	0.9831 (89)
MIT 2	17.8795	18.1202	18.5172	19.0290	19.4227	19.6455	19.7004	19.6953	19.5539	19.0488	18.3886	17.8501 (90)
Living area fraction	18.0869	18.3183	18.7002	19.1929	19.5747	19.7928	19.8486	19.8426	19.7014	19.2109	18.5753	18.0580 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0869	18.3183	18.7002	19.1929	19.5747	19.7928	19.8486	19.8426	19.7014	19.2109	18.5753	18.0580 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	897.1261	1013.1108	1108.0997	1153.8901	1062.0933	787.3435	519.1147	542.7142	783.9904	891.5438	864.9718	854.8989 (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	2331.0149	2262.3813	2051.3881	1708.4167	1303.8575	850.0059	531.7603	562.3262	920.9587	1425.7423	1909.4230	2317.7591 (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 Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating	1066.8132	839.5098	701.8065	399.2591	179.8726	0.0000	0.0000	0.0000	0.0000	397.4437	752.0049	1088.3680 (98)
Space heating per m2												5425.0779 (98)
												(98) / (4) = 43.5889 (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 %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5981.3428 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1066.8132	839.5098	701.8065	399.2591	179.8726	0.0000	0.0000	0.0000	0.0000	397.4437	752.0049	1088.3680 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1176.1998	925.5896	773.7669	440.1975	198.3160	0.0000	0.0000	0.0000	0.0000	438.1959	829.1123	1199.9648 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
Efficiency of water heater (217)m	88.6483	88.4529	88.0193	87.0049	84.9799	80.0000	80.0000	80.0000	80.0000	86.9057	88.1895	80.0000 (216)
Fuel for water heating, kWh/month	251.8218	222.5402	235.0888	213.5089	214.4479	203.8962	196.1548	214.7819	214.2582	221.6340	230.5586	245.6666 (219)
Water heating fuel used												2664.3578 (219)
Annual totals kWh/year												
Space heating fuel - main system												5981.3428 (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)												463.2704 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.30 * 1029 * 1.00) =										-1893.7036		-1893.7036 (233)
Total delivered energy for all uses												7290.2675 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5981.3428	3.4800	208.1507 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2664.3578	3.4800	92.7197 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	463.2704	13.1900	61.1054 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1893.7036	13.1900	-249.7795 (252)
Total energy cost			242.0888 (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] =	0.6000 (257)
SAP value		91.6299
SAP rating (Section 12)		92 (258)
SAP band		A

#### 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	5981.3428	0.2160	1291.9700 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2664.3578	0.2160	575.5013 (264)
Space and water heating			1867.4713 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Energy saving/generation technologies			
PV Unit	-1893.7036	0.5190	-982.8321 (269)
Total kg/year			1164.0015 (272)
CO2 emissions per m2			9.3500 (273)
EI value			90.7957

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI rating  
EI band

91 (274)  
B

-----  
Calculation of stars for heating and DHW  
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Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.25) / 0.9070 = 4.115$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.25) / 0.9070 = 0.2554$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8508 = 4.090$ , stars = 4
Water heating environmental impact	$0.216 / 0.8508 = 0.2539$ , stars = 4

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	2.4700 (2b)	163.4646 (1b) - (3b)
First floor	58.2800 (1c)	2.7300 (2c)	159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)
Dwelling volume			

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate					0.3740 (18)
Number of sides sheltered				0	0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3740 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate												
Effective ac	0.3834	0.3553	0.3647	0.3460	0.3366	0.3086	0.3086	0.2992	0.2992	0.3179	0.3086	0.3460 (22b)
	0.5735	0.5631	0.5665	0.5598	0.5567	0.5476	0.5476	0.5448	0.5448	0.5505	0.5476	0.5598 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	61.0457	59.9429	60.3012	59.5939	59.2543	58.2911	58.2911	57.9886	57.9886	58.6028	58.2911	59.5939 (38)
Heat transfer coeff	164.7933	163.6905	164.0488	163.3415	163.0019	162.0387	162.0387	161.7362	161.7362	162.3504	162.0387	163.3415 (39)
Average = Sum(39)m / 12 =												162.8464 (39)
HLP	1.3241	1.3152	1.3181	1.3124	1.3097	1.3019	1.3019	1.2995	1.2995	1.3044	1.3019	1.3124 (40)
HLP (average)												1.3084 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy content (annual)	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)	
Energy content (annual)												Total = Sum(45)m =	1613.9319 (45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)	
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.0530 (55)	
Total storage loss													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)	
If cylinder contains dedicated solar storage													
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (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													
	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)	
												Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h													
	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)	
												Total per year (kWh/year) = Sum(64)m =	2272.1729 (64)
Heat gains from water heating, kWh/month													
	100.3616	89.0569	94.9378	87.0590	86.7297	79.5291	78.3129	83.2678	82.2854	90.1795	92.8994	98.6061 (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	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	65.5807	58.2482	47.3706	35.8626	26.8077	22.6322	24.4549	31.7874	42.6650	54.1730	63.2279	67.4034 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	434.1960	438.7015	427.3476	403.1764	372.6645	343.9877	324.8298	320.3242	331.6782	355.8494	386.3613	415.0381 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532 (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)												
	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)												
	134.8946	132.5251	127.6046	120.9152	116.5722	110.4571	105.2593	111.9190	114.2852	121.2089	129.0270	132.5350 (72)
Total internal gains	750.4049	745.2085	718.0564	675.6878	631.7781	592.8106	570.2777	579.7643	604.3620	646.9650	694.3497	730.7101 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W						
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
Northeast	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882 (75)						
Southeast	8.7400	45.2918	0.6300	0.7000	0.7700	120.9769 (77)						
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)						
Northwest	10.3800	14.6223	0.6300	0.7000	0.7700	46.3859 (81)						
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)						
Solar gains	216.1892	336.3742	517.4219	735.0122	855.2123	958.3667	893.2483	782.5051	621.3735	412.9742	256.9657	172.0319 (83)
Total gains	966.5941	1081.5827	1235.4784	1410.7000	1486.9904	1551.1773	1463.5259	1362.2693	1225.7355	1059.9392	951.3154	902.7421 (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	36.0635	36.3064	36.2271	36.3840	36.4598	36.6765	36.6765	36.7451	36.7451	36.6061	36.6765	36.3840	
alpha	3.4042	3.4204	3.4151	3.4256	3.4307	3.4451	3.4451	3.4497	3.4497	3.4404	3.4451	3.4256	
util living area	0.9789	0.9676	0.9372	0.8651	0.7364	0.5349	0.3783	0.4245	0.6850	0.8939	0.9635	0.9827 (86)	
MIT	19.7017	19.8557	20.1341	20.4690	20.7348	20.8772	20.9119	20.9072	20.8152	20.4906	20.0591	19.6729 (87)	
Th 2	19.8220	19.8289	19.8267	19.8311	19.8333	19.8393	19.8393	19.8412	19.8412	19.8374	19.8393	19.8311 (88)	
util rest of house	0.9738	0.9598	0.9215	0.8314	0.6715	0.4366	0.2572	0.2983	0.5910	0.8588	0.9529	0.9784 (89)	
MIT 2	18.1202	18.3469	18.7417	19.2054	19.5440	19.6971	19.7218	19.7218	19.6473	19.2521	18.6503	18.0855 (90)	
Living area fraction												fLA = Living area / (4) =	0.1243 (91)
MIT	18.3168	18.5345	18.9147	19.3624	19.6920	19.8438	19.8697	19.8691	19.7924	19.4061	18.8254	18.2828 (92)	
Temperature adjustment													
adjusted MIT	18.3168	18.5345	18.9147	19.3624	19.6920	19.8438	19.8697	19.8691	19.7924	19.4061	18.8254	18.2828 (93)	

#### 8. Space heating requirement

Utilisation	0.9647	0.9482	0.9061	0.8154	0.6626	0.4370	0.2604	0.3015	0.5866	0.8425	0.9405	0.9704 (94)
Useful gains	932.4949	1025.5272	1119.4108	1150.2420	985.3210	677.8110	381.1575	410.6890	718.9983	893.0147	894.6936	876.0471 (95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000 (96)
Heat loss rate W												
	2194.5169	2117.2505	1905.3831	1578.2770	1139.7095	703.8569	383.9849	415.5181	791.2856	1283.5527	1754.1317	2169.6289 (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 Designed)

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

Space heating	938.9444	733.6381	584.7634	308.1852	114.8651	0.0000	0.0000	0.0000	0.0000	290.5602	618.7954	962.4249 (98)
Space heating per m2												4552.1766 (98)
												(98) / (4) = 36.5754 (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 %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5018.9379 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	938.9444	733.6381	584.7634	308.1852	114.8651	0.0000	0.0000	0.0000	0.0000	290.5602	618.7954	962.4249 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1035.2198	808.8623	644.7226	339.7852	126.6429	0.0000	0.0000	0.0000	0.0000	320.3531	682.2441	1061.1079 (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	223.2356	196.8433	206.9235	185.7632	182.2375	163.1170	156.9238	171.8255	171.4066	192.6126	203.3286	217.9558 (64)
Efficiency of water heater (217)m	88.4282	88.2043	87.6364	86.3562	83.8232	80.0000	80.0000	80.0000	80.0000	86.1088	87.7958	80.0000 (216)
Fuel for water heating, kWh/month	252.4485	223.1675	236.1160	215.1127	217.4071	203.8962	196.1548	214.7819	214.2582	223.6850	231.5926	246.2388 (219)
Water heating fuel used												2674.8593 (219)
Annual totals kWh/year												
Space heating fuel - main system												5018.9379 (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)												463.2704 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.30 * 1139 * 1.00) =										-2095.9229		-2095.9229 (233)
Total delivered energy for all uses												6136.1448 (238)

#### 10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5018.9379	9.7400	488.8445 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2674.8593	9.7400	260.5313 (247)
Pumps and fans for heating	75.0000	36.8500	27.6375 (249)
Energy for lighting	463.2704	36.8500	170.7152 (250)
Additional standing charges			104.0000 (251)
Energy saving/generation technologies			
PV Unit	-2095.9229	36.8500	-772.3476 (252)
Total energy cost			279.3809 (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	5018.9379	0.2160	1084.0906 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2674.8593	0.2160	577.7696 (264)
Space and water heating			1661.8602 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Energy saving/generation technologies			
PV Unit	-2095.9229	0.5190	-1087.7840 (269)
Total kg/year			853.4386 (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	5018.9379	1.2200	6123.1042 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2674.8593	1.2200	3263.3284 (264)
Space and water heating			9386.4326 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy for lighting	463.2704	3.0700	1422.2403 (268)
Energy saving/generation technologies			
PV Unit	-2095.9229	3.0700	-6434.4832 (269)
Primary energy kWh/year			4604.4396 (272)
Primary energy kWh/m <sup>2</sup> /year			36.9953 (273)

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92  
 Current environmental impact rating: B 91

(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	-£ 115	-271 kg (31.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£115	2.17 kg/m <sup>2</sup>	A 93
Total Savings	£115	2.17 kg/m <sup>2</sup>	A 93

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

Fuel prices for cost data on this page from database revision number 512 TEST (15 Feb 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	£198	£217	-£18
Mains gas	£853	£720	£134
Space heating	£620	£625	-£5
Water heating	£261	£140	£120
Lighting	£171	£171	£0
Generated (PV)	-£772	-£772	£0
Total cost of fuels	£279	£165	£116
Total cost of uses	£280	£164	£115
Delivered energy	49 kWh/m <sup>2</sup>	39 kWh/m <sup>2</sup>	11 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.9 tonnes	0.6 tonnes	0.3 tonnes
CO2 emissions per m <sup>2</sup>	7 kg/m <sup>2</sup>	5 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	37 kWh/m <sup>2</sup>	25 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	x 2.4700 (2b)	= 163.4646 (1b) - (3b)
First floor	58.2800 (1c)	x 2.7300 (2c)	= 159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 322.5690 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1240 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3740	(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) =		0.3740 (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												
Effective ac	0.4769	0.4675	0.4582	0.4114	0.4021	0.3553	0.3553	0.3460	0.3740	0.4021	0.4208	0.4395 (22b)
	0.6137	0.6093	0.6050	0.5846	0.5808	0.5631	0.5631	0.5598	0.5699	0.5808	0.5885	0.5966 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	65.3265	64.8566	64.3959	62.2322	61.8274	59.9429	59.9429	59.5939	60.6688	61.8274	62.6464	63.5025 (38)
Heat transfer coeff	169.0741	168.6042	168.1435	165.9798	165.5750	163.6905	163.6905	163.3415	164.4164	165.5750	166.3939	167.2501 (39)
Average = Sum(39)m / 12 =												165.9779 (39)
HLP	1.3585	1.3547	1.3510	1.3336	1.3303	1.3152	1.3152	1.3124	1.3210	1.3303	1.3369	1.3438 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)
Distribution loss (46)m = 0.15 x (45)m	25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.9848	20.3079	20.9848	20.3079	20.9848 (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	211.5774	186.3133	193.8695	167.7275	157.7850	139.2281	132.2387	148.0708	154.7215	179.5586	192.0464	206.2976 (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												1.1237 (H8)
Utilisation factor												0.5893 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												102.5768 (H14)
Volume ratio Veff/V												1.1260 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-939.7575 (H17)
Solar input	-27.2511	-45.4742	-77.4478	-103.7954	-128.2304	-126.0709	-124.4049	-108.6932	-85.1285	-58.1328	-32.3237	-22.8045 (63)
Solar input (sum of months) = Sum(63)m =												-939.7575 (63)
Output from w/h	184.3263	140.8390	116.4217	63.9321	29.5545	13.1572	7.8338	39.3777	69.5930	121.4258	159.7227	183.4930 (64)
Total per year (kWh/year) = Sum(64)m =												1129.6769 (64)
Heat gains from water heating, kWh/month	91.0350	80.6329	84.4947	72.6304	67.1677	60.4180	58.5648	64.2640	68.9373	79.7363	83.8737	89.2795 (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	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.5807	58.2482	47.3706	35.8626	26.8077	22.6322	24.4549	31.7874	42.6650	54.1730	63.2279	67.4034 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	434.1960	438.7015	427.3476	403.1764	372.6645	343.9877	324.8298	320.3242	331.6782	355.8494	386.3613	415.0381 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532 (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)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609 (71)
Water heating gains (Table 5)	122.3589	119.9894	113.5681	100.8755	90.2792	83.9139	78.7162	86.3764	95.7463	107.1724	116.4913	119.9993 (72)
Total internal gains	737.8692	732.6728	704.0199	655.6481	605.4850	566.2674	543.7345	554.2216	585.8231	632.9284	681.8140	718.1744 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W						
Northeast	1.3400	11.2829	0.6300	0.7000	0.7700	4.6206 (75)						
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	10.3800	11.2829	0.6300	0.7000	0.7700	35.7925 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	172.3343	313.9113	480.9620	677.8829	830.9722	855.6650	812.2369	693.8811	548.7922	361.0666	210.1887	145.0070 (83)
Total gains	910.2035	1046.5841	1184.9819	1333.5309	1436.4573	1421.9324	1355.9713	1248.1027	1134.6153	993.9951	892.0027	863.1814 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	35.1504	35.2483	35.3449	35.8057	35.8932	36.3064	36.3064	36.3840	36.1461	35.8932	35.7165	35.5337
alpha	3.3434	3.3499	3.3563	3.3870	3.3929	3.4204	3.4204	3.4256	3.4097	3.3929	3.3811	3.3689
util living area	0.9845	0.9744	0.9523	0.8994	0.7984	0.6447	0.5007	0.5549	0.7732	0.9280	0.9751	0.9869 (86)
MIT	19.5403	19.7059	19.9811	20.3382	20.6375	20.8265	20.8913	20.8787	20.7353	20.3448	19.8826	19.5144 (87)
Th 2	19.7953	19.7982	19.8011	19.8146	19.8171	19.8289	19.8289	19.8311	19.8244	19.8171	19.8120	19.8067 (88)
util rest of house	0.9808	0.9682	0.9405	0.8735	0.7460	0.5547	0.3802	0.4326	0.6963	0.9040	0.9681	0.9838 (89)
MIT 2	17.8673	18.1086	18.5056	19.0164	19.4134	19.6424	19.6996	19.6941	19.5488	19.0388	18.3770	17.8378 (90)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Living area fraction										fLA = Living area / (4) =	0.1243 (91)	
MIT	18.0753	18.3072	18.6890	19.1807	19.5656	19.7895	19.8477	19.8414	19.6963	19.2011	18.5642	18.0462 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0753	18.3072	18.6890	19.1807	19.5656	19.7895	19.8477	19.8414	19.6963	19.2011	18.5642	18.0462 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9732	0.9578	0.9261	0.8566	0.7331	0.5514	0.3822	0.4338	0.6865	0.8877	0.9577	0.9771	(94)
Useful gains	885.8211	1002.4304	1097.4582	1142.2679	1053.1209	784.0497	518.2721	541.4103	778.9536	882.3609	854.3086	843.4337	(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													
Month fracti	2329.0400	2260.5043	2049.5056	1706.3857	1302.3441	849.4795	531.6238	562.1162	920.1208	1424.1322	1907.5658	2315.7764	(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	1073.7548	845.4257	708.3232	406.1648	185.4220	0.0000	0.0000	0.0000	0.0000	403.0779	758.3452	1095.4229	(98)
Space heating per m2													(98) / (4) = 43.9976 (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 %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													6037.4163 (211)
Space heating requirement	1073.7548	845.4257	708.3232	406.1648	185.4220	0.0000	0.0000	0.0000	0.0000	403.0779	758.3452	1095.4229	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1183.8532	932.1121	780.9517	447.8113	204.4344	0.0000	0.0000	0.0000	0.0000	444.4078	836.1027	1207.7430	(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	184.3263	140.8390	116.4217	63.9321	29.5545	13.1572	7.8338	39.3777	69.5930	121.4258	159.7227	183.4930	(64)
Efficiency of water heater (217)m	88.9568	89.0001	89.0193	89.0797	89.0624	80.0000	80.0000	80.0000	80.0000	87.9759	88.6375	88.9923	(216)
Fuel for water heating, kWh/month	207.2088	158.2459	130.7826	71.7696	33.1841	16.4465	9.7922	49.2221	86.9913	138.0217	180.1977	206.1899	(219)
Water heating fuel used													1288.0523 (219)
Annual totals kWh/year													
Space heating fuel - main system													6037.4163 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													463.2704 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.30 * 1029 * 1.00) =										-1893.7036			-1893.7036 (233)
Total delivered energy for all uses													6020.0355 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6037.4163	3.4800	210.1021	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1288.0523	3.4800	44.8242	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	463.2704	13.1900	61.1054	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1893.7036	13.1900	-249.7795	(252)
Total energy cost			202.7397	(255)

#### 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.5025 (257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	92.9904
SAP rating (Section 12)		93 (258)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP band

A

-----  
 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6037.4163	0.2160	1304.0819 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1288.0523	0.2160	278.2193 (264)
Space and water heating			1582.3012 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Energy saving/generation technologies			
PV Unit	-1893.7036	0.5190	-982.8321 (269)
Total kg/year			904.7814 (272)
CO2 emissions per m2			7.2700 (273)
EI value			92.8455
EI rating			93 (274)
EI band			A

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.1800 (1b)	x 2.4700 (2b)	= 163.4646 (1b) - (3b)
First floor	58.2800 (1c)	x 2.7300 (2c)	= 159.1044 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.4600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 322.5690 (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) = 0.1240 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3740 (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)	=	0.3740 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate	0.3834	0.3553	0.3647	0.3460	0.3366	0.3086	0.3086	0.2992	0.2992	0.3179	0.3086	0.3460 (22b)
Effective ac	0.5735	0.5631	0.5665	0.5598	0.5567	0.5476	0.5476	0.5448	0.5448	0.5505	0.5476	0.5598 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Windows (Uw = 1.40)			21.8000	1.3258	28.9015		(27)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Ground Floor			66.1800	0.1200	7.9416	75.0000	4963.5000 (28a)
External Walls	185.1100	24.1300	160.9800	0.1800	28.9764	60.0000	9658.8000 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	5.5200	1.8000	3.7200	0.1400	0.5208	9.0000	33.4800 (30)
Pitched Cold Roof	58.2800		58.2800	0.1000	5.8280	9.0000	524.5200 (30)
Total net area of external elements Aum(A, m2)			317.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	78.1632		(33)
Internal Wall - Masonry			39.5900			75.0000	2969.2500 (32c)
Internal Wall on timber frame			125.1600			9.0000	1126.4400 (32c)
Internal Floor			58.2800			18.0000	1049.0400 (32d)
Internal Ceiling			58.2800			18.0000	1049.0400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21394.8600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.9015 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.5844 (36)
Total fabric heat loss						(33) + (36) =	103.7476 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	61.0457	59.9429	60.3012	59.5939	59.2543	58.2911	58.2911	57.9886	57.9886	58.6028	58.2911	59.5939 (38)
Heat transfer coeff	164.7933	163.6905	164.0488	163.3415	163.0019	162.0387	162.0387	161.7362	161.7362	162.3504	162.0387	163.3415 (39)
Average = Sum(39)m / 12 =												162.8464 (39)
HLP	1.3241	1.3152	1.3181	1.3124	1.3097	1.3019	1.3019	1.2995	1.2995	1.3044	1.3019	1.3124 (40)
HLP (average)												1.3084 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.8790 (42)
Average daily hot water use (litres/day)												102.5768 (43)
Daily hot water use	112.8344	108.7314	104.6283	100.5252	96.4222	92.3191	92.3191	96.4222	100.5252	104.6283	108.7314	112.8344 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Energy conte	167.3302	146.3481	151.0181	131.6612	126.3321	109.0150	101.0184	115.9201	117.3046	136.7072	149.2266	162.0504 (45)																																	
Energy content (annual)												Total = Sum(45)m = 1613.9319 (45)																																	
Distribution loss (46)m = 0.15 x (45)m												25.0995	21.9522	22.6527	19.7492	18.9498	16.3522	15.1528	17.3880	17.5957	20.5061	22.3840	24.3076 (46)																						
Water storage loss:																																													
Store volume																							210.0000 (47)																						
a) If manufacturer declared loss factor is known (kWh/day):																							1.9500 (48)																						
Temperature factor from Table 2b																							0.5400 (49)																						
Enter (49) or (54) in (55)																							1.0530 (55)																						
Total storage loss																							32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	31.5900	32.6430	31.5900	32.6430	31.5900	32.6430	31.5900	32.6430 (56)								
If cylinder contains dedicated solar storage																							20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.3079	20.9848	20.3079	20.9848	20.3079	20.9848 (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																							211.5774	186.3133	193.8695	167.7275	157.7850	139.2281	132.2387	148.0708	154.7215	179.5586	192.0464	206.2976 (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																																		1190.5240 (H5)											
Overshading factor																																		0.8000 (H6)											
Solar energy available																																		2000.0804 (H7)											
Adjustment factor for showers																																		1.0000 (H7a)											
Solar-to-load ratio																																		1.2393 (H8)											
Utilisation factor																																		0.5538 (H9)											
Collector performance factor																																		0.8793 (H10)											
Dedicated solar storage volume																																		75.0000 (H11)											
Effective solar volume																																		115.5000 (H13)											
Daily hot water demand																																		102.5768 (H14)											
Volume ratio Veff/V																																		1.1260 (H15)											
Solar storage volume factor																																		1.0000 (H16)											
Solar input																																		-973.9018 (H17)											
Solar input	-32.2899	-45.9086	-78.1489	-105.1277	-123.0899	-131.6917	-127.5946	-114.3992	-90.2385	-62.5426	-37.3012	-25.5690 (63)																																	
Solar input (sum of months) = Sum(63)m =																							-973.9018 (63)																						
Output from w/h																																		179.2875	140.4047	115.7207	62.5998	34.6951	7.5364	4.6441	33.6716	64.4830	117.0160	154.7452	180.7286 (64)
Total per year (kWh/year) = Sum(64)m =																																		1095.5326 (64)											
Heat gains from water heating, kWh/month																																		91.0350	80.6329	84.4947	72.6304	67.1677	60.4180	58.5648	64.2640	68.9373	79.7363	83.8737	89.2795 (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	(66)																				
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	172.7413	66																				
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	65.5807	58.2482	47.3706	35.8626	26.8077	22.6322	24.4549	31.7874	42.6650	54.1730	63.2279	67.4034	67																				
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	434.1960	438.7015	427.3476	403.1764	372.6645	343.9877	324.8298	320.3242	331.6782	355.8494	386.3613	415.0381	68																				
Pumps, fans	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	55.1532	69																				
Losses e.g. evaporation (negative values) (Table 5)	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																				
Water heating gains (Table 5)	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	-115.1609	71																				
Total internal gains	122.3589	119.9894	113.5681	100.8755	90.2792	83.9139	78.7162	86.3764	95.7463	107.1724	116.4913	119.9993	72																				
	737.8692	732.6728	704.0199	655.6481	605.4850	566.2674	543.7345	554.2216	585.8231	632.9284	681.8140	718.1744	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	1.3400	14.6223	0.6300	0.7000	0.7700	5.9882 (75)							
Southeast	8.7400	45.2918	0.6300	0.7000	0.7700	120.9769 (77)							
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)							
Northwest	10.3800	14.6223	0.6300	0.7000	0.7700	46.3859 (81)							
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)							
Solar gains	216.1892	336.3742	517.4219	735.0122	855.2123	958.3667	893.2483	782.5051	621.3735	412.9742	256.9657	172.0319	83
Total gains	954.0584	1069.0470	1221.4418	1390.6603	1460.6974	1524.6341	1436.9828	1336.7267	1207.1966	1045.9027	938.7797	890.2063	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)																																	
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec																					
alpha	36.0635	36.3064	36.2271	36.3840	36.4598	36.6765	36.6765	36.7451	36.7451	36.6061	36.6765	36.3840																					
util living area	3.4042	3.4204	3.4151	3.4256	3.4307	3.4451	3.4451	3.4497	3.4497	3.4404	3.4451	3.4256																					
MIT	0.9797	0.9687	0.9390	0.8691	0.7438	0.5425	0.3848	0.4318	0.6916	0.8971	0.9648	0.9834	86																				
MIT 2	19.6933	19.8478	20.1262	20.4605	20.7285	20.8752	20.9114	20.9064	20.8118	20.4839	20.0512	19.6644	87																				
Th 2	19.8220	19.8289	19.8267	19.8311	19.8333	19.8393	19.8393	19.8412	19.8412	19.8374	19.8393	19.8311	88																				
util rest of house	0.9748	0.9610	0.9237	0.8361	0.6793	0.4433	0.2618	0.3038	0.5978	0.8627	0.9546	0.9793	89																				
MIT 2	18.1083	18.3356	18.7308	19.1946	19.5374	19.6957	19.7216	19.7215	19.6444	19.2437	18.6392	18.0733	90																				

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Living area fraction									fLA = Living area / (4) =	0.1243 (91)		
MIT	18.3053	18.5236	18.9042	19.3520	19.6855	19.8423	19.8695	19.8688	19.7895	19.3978	18.8147	18.2711 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3053	18.5236	18.9042	19.3520	19.6855	19.8423	19.8695	19.8688	19.7895	19.3978	18.8147	18.2711 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9496	0.9083	0.8199	0.6701	0.4436	0.2651	0.3070	0.5931	0.8464	0.9423	0.9715	(94)
Useful gains	921.5089	1015.1895	1109.4861	1140.2596	978.8092	676.3522	380.9595	410.3499	716.0264	885.2357	884.6468	864.8340	(95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000	(96)
Heat loss rate W													
Month fracti	2192.6239	2115.4659	1903.6560	1576.5673	1138.6449	703.6278	383.9507	415.4611	790.8083	1282.2156	1752.4056	2167.7146	(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	945.7096	739.3858	590.8624	314.1415	118.9178	0.0000	0.0000	0.0000	0.0000	295.3531	624.7863	969.3431	(98)
Space heating per m2												4598.4996	(98)
												(98) / (4) =	36.9476 (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 %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5070.0106 (211)
Space heating requirement	945.7096	739.3858	590.8624	314.1415	118.9178	0.0000	0.0000	0.0000	0.0000	295.3531	624.7863	969.3431	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1042.6787	815.1993	651.4470	346.3523	131.1111	0.0000	0.0000	0.0000	0.0000	325.6373	688.8493	1068.7355	(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	179.2875	140.4047	115.7207	62.5998	34.6951	7.5364	4.6441	33.6716	64.4830	117.0160	154.7452	180.7286	(64)
Efficiency of water heater (217)m	88.8070	88.8045	88.7558	88.7281	88.0404	80.0000	80.0000	80.0000	80.0000	87.3835	88.3541	88.8329	(216)
Fuel for water heating, kWh/month	201.8843	158.1054	130.3809	70.5524	39.4081	9.4205	5.8051	42.0895	80.6038	133.9109	175.1420	203.4478	(219)
Water heating fuel used													1250.7508 (219)
Annual totals kWh/year													
Space heating fuel - main system													5070.0106 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													463.2704 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.30 * 1139 * 1.00) =										-2095.9229			-2095.9229 (233)
Total delivered energy for all uses													4813.1090 (238)

#### 10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5070.0106	9.7400	493.8190	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1250.7508	9.7400	121.8231	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	463.2704	36.8500	170.7152	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-2095.9229	36.8500	-772.3476	(252)
Total energy cost			164.0722	(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	5070.0106	0.2160	1095.1223	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Water heating (other fuel)	1250.7508	0.2160	270.1622 (264)
Space and water heating			1365.2845 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	463.2704	0.5190	240.4374 (268)
Energy saving/generation technologies			
PV Unit	-2095.9229	0.5190	-1087.7840 (269)
Total kg/year			582.8129 (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	5070.0106	1.2200	6185.4129 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1250.7508	1.2200	1525.9160 (264)
Space and water heating			7711.3289 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	463.2704	3.0700	1422.2403 (268)
Energy saving/generation technologies			
PV Unit	-2095.9229	3.0700	-6434.4832 (269)
Primary energy kWh/year			3082.8360 (272)
Primary energy kWh/m2/year			24.7697 (273)

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

##### Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	171.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

##### Overheating Calculation

Summer ventilation heat loss coefficient	851.58 (P1)
Transmission heat loss coefficient	103.75 (37)
Summer heat loss coefficient	955.33 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North	1.000	1.00	1.000	1.000 (P8)
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South 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	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	1.3400	106.0502	0.6300	0.7000	0.9000	50.7621
South East	8.7400	127.3119	0.6300	0.7000	0.9000	397.4696
South West	1.3400	127.3119	0.6300	0.7000	0.9000	60.9393
North West	10.3800	106.0502	0.6300	0.7000	0.9000	393.2172
North	1.8000	217.0000	0.6300	0.7000	1.0000	155.0291
total:						1057.4173

	Jun	Jul	Aug	
Solar gains	1141	1057	922	(P3)
Internal gains	590	567	577	
Total summer gains	1731	1625	1499	(P5)
Summer gain/loss ratio	1.81	1.70	1.57	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 171.9)	0.80	0.80	0.80	
Threshold temperature	18.01	19.80	19.67	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature:	Not significant			



# PREDICTED ENERGY ASSESSMENT

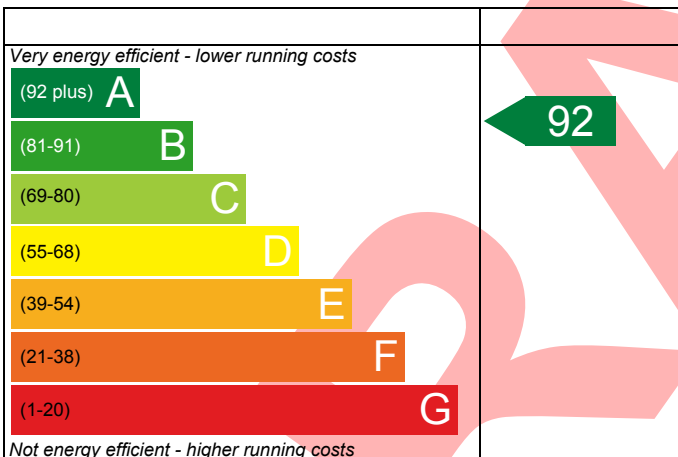
Tree House, Larg Drive,  
Winchester,  
Hampshire,  
SO22 6NU

Dwelling type: House, Detached  
Date of assessment: 01/03/2023  
Produced by: Scott Spearing  
Total floor area: 124.46 m<sup>2</sup>

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

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.

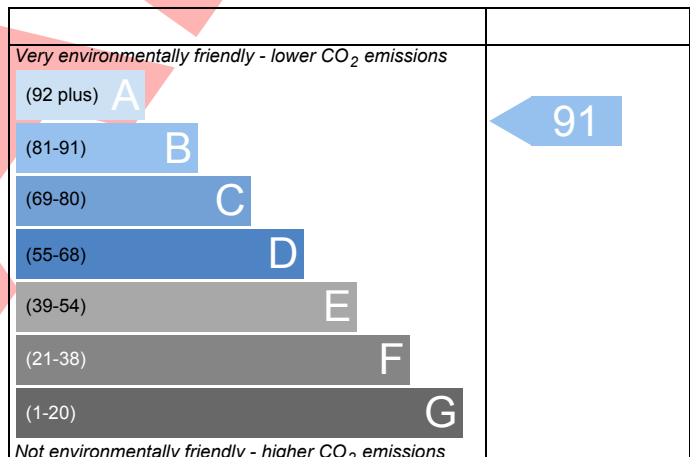
## Energy Efficiency Rating



**England** EU Directive 2002/91/EC

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

## Environmental Impact (CO<sub>2</sub>) Rating



**England** EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

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