



# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.33  
Printed on 23 April 2021 at 11:41:48

## Project Information:

**Assessed By:** Chris Mcdonald (STRO007579) **Building Type:** Detached House

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 168.84m<sup>2</sup>  
**Site Reference :** Broome Farm Barn **Plot Reference:** Phase 2 Plot 2 LPG  
**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

## Client Details:

**Name:** Neil Homer  
**Address :**

**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 system: Bulk LPG  
Fuel factor: 1.06 (lpg)  
Target Carbon Dioxide Emission Rate (TER) 16.07 kg/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.05 kg/m<sup>2</sup> **OK**

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 56.5 kWh/m<sup>2</sup>  
Dwelling Fabric Energy Efficiency (DFEE) 50.1 kWh/m<sup>2</sup> **OK**

## 2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	<b>OK</b>
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	<b>OK</b>
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	<b>OK</b>
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	<b>OK</b>

## 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 systems with radiators or underfloor heating - LPG  
Data from manufacturer  
Efficiency 90.0 % SEDBUK2009  
Minimum 88.0 % **OK**  
  
Secondary heating system: None

## 5 Cylinder insulation

Hot water Storage: Measured cylinder loss: 1.79 kWh/day  
Permitted by DBSCG: 2.30 kWh/day **OK**  
Primary pipework insulated: Yes **OK**

# Regulations Compliance Report



## 6 Controls

Space heating controls	TTZC by plumbing and electrical services	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	100.0%	
Minimum	75.0%	OK

## 8 Mechanical ventilation

Not applicable

## 9 Summertime temperature

Overheating risk (Midlands):	Not significant	OK
Based on:		
Overshading:	Average or unknown	
Windows facing: South	19.53m <sup>2</sup>	
Windows facing: West	1.26m <sup>2</sup>	
Windows facing: North	18.9m <sup>2</sup>	
Windows facing: East	1.26m <sup>2</sup>	
Ventilation rate:	8.00	
Blinds/curtains:	Dark-coloured curtain or roller blind Closed 100% of daylight hours	

## 10 Key features

Roofs U-value	0.1 W/m <sup>2</sup> K
Photovoltaic array	

# Predicted Energy Assessment



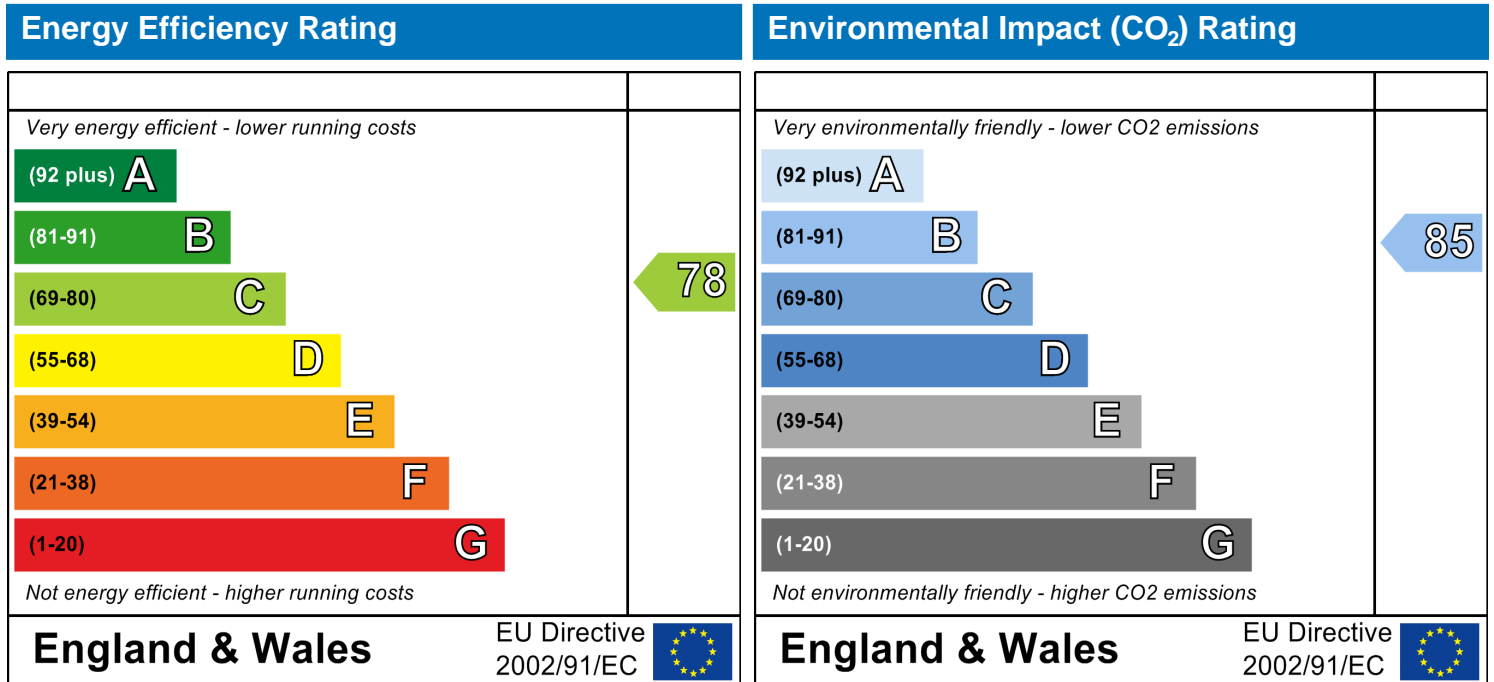
Land West of Broome Farm Barn  
Broome  
Craven Arms

Dwelling type:  
Date of assessment:  
Produced by:  
Total floor area:

Detached House  
23 April 2021  
Chris McDonald  
168.84 m<sup>2</sup>

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO<sub>2</sub>) emissions.



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.

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.

# SAP Input



## Property Details: Phase 2 Plot 2 LPG

Address: Land West of Broome Farm Barn, Broome, Craven Arms  
 Located in: England  
 Region: Midlands  
 UPRN:  
 Date of assessment: 23 April 2021  
 Date of certificate: 23 April 2021  
 Assessment type: New dwelling design stage  
 Transaction type: Marketed sale  
 Tenure type: Owner-occupied  
 Related party disclosure: No related party  
 Thermal Mass Parameter: Indicative Value Low  
 Water use <= 125 litres/person/day: True  
 PCDF Version: 474

## Property description:

Dwelling type: House  
 Detachment: Detached  
 Year Completed: 2021  
 Floor Location: Floor area: Storey height:  
 Floor 0 90.19 m<sup>2</sup> 2.7 m  
 Floor 1 78.65 m<sup>2</sup> 2.41 m  
 Living area: 28.03 m<sup>2</sup> (fraction 0.166)  
 Front of dwelling faces: North West

## Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
North East	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	Wood
South East	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	Wood
South West	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	Wood
North West	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	Wood

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
North East	16mm or more	0.7	0.63	1.4	19.53	1
South East	16mm or more	0.7	0.63	1.4	1.26	1
South West	16mm or more	0.7	0.63	1.4	18.9	1
North West	16mm or more	0.7	0.63	1.4	1.26	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
North East		External wall	South	0	0
South East		External wall	West	0	0
South West		External wall	North	0	0
North West		External wall	East	0	0

Overshading: Average or unknown

## Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External wall	200.79	40.95	159.84	0.16	0	False	N/A
Flat ceiling	90.19	0	90.19	0.1	0		N/A
Ground floor	90.91			0.14			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							

## Thermal bridges:

# SAP Input



Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0842

	Length	Psi-value		
[Approved]	23.3	0.5	E1	Steel lintel with perforated steel base plate
[Approved]	23.3	0.04	E3	Sill
[Approved]	49.9	0.05	E4	Jamb
[Approved]	43.01	0.16	E5	Ground floor (normal)
[Approved]	43.01	0.07	E6	Intermediate floor within a dwelling
[Approved]	23.08	0.06	E10	Eaves (insulation at ceiling level)
[Approved]	13.64	0.24	E12	Gable (insulation at ceiling level)
[Approved]	25.76	0.09	E16	Corner (normal)
[Approved]	5.76	-0.09	E17	Corner (inverted internal area greater than external area)
	9	0.08	E14	Flat roof

## Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	5
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	5

## Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: bulk LPG Info Source: Manufacturer Declaration Manufacturer's data Efficiency: 90.0% (SEDBUK2009) Regular condensing with automatic ignition Fuel Burning Type: Underfloor heating, pipes in screed above insulation Central heating pump : 2013 or later Design flow temperature: Design flow temperature <= 35°C Room-sealed Boiler interlock: Yes
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## Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110
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## Secondary heating system:

Secondary heating system:	None
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## Water heating:

Water heating:	From main heating system Water code: 901 Fuel :bulk LPG Hot water cylinder Cylinder volume: 210 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False
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## Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	No

# SAP Input



Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Rural
EPC language:	English
Wind turbine:	No
Photovoltaics:	<u>Photovoltaic 1</u> Installed Peak power: 2 Tilt of collector: 45° Overshading: Modest Collector Orientation: North West
Assess Zero Carbon Home:	No

# SAP WorkSheet: New dwelling design stage



## User Details:

**Assessor Name:** Chris Mcdonald      **Stroma Number:** STRO007579  
**Software Name:** Stroma FSAP 2012      **Software Version:** Version: 1.0.5.33

## Property Address: Phase 2 Plot 2 LPG

**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )	Av. Height(m)	Volume(m <sup>3</sup> )
Ground floor	90.19 (1a)	2.7 (2a)	243.51 (3a)
First floor	78.65 (1b)	2.41 (2b)	189.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	168.84 (4)		
Dwelling volume			433.06 (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				5	50 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)

### Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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### Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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# SAP WorkSheet: New dwelling design stage



Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,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
Windows Type 1			<input type="text" value="19.53"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.89"/>		(27)
Windows Type 2			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Windows Type 3			<input type="text" value="18.9"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.06"/>		(27)
Windows Type 4			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Floor			<input type="text" value="90.91"/>	x <input type="text" value="0.14"/>	= <input type="text" value="12.7274"/>	<input type="text"/>	<input type="text"/> (28)
Walls	<input type="text" value="200.79"/>	<input type="text" value="40.95"/>	<input type="text" value="159.84"/>	x <input type="text" value="0.16"/>	= <input type="text" value="25.57"/>	<input type="text"/>	<input type="text"/> (29)
Roof	<input type="text" value="90.19"/>	<input type="text" value="0"/>	<input type="text" value="90.19"/>	x <input type="text" value="0.1"/>	= <input type="text" value="9.02"/>	<input type="text"/>	<input type="text"/> (30)
Total area of elements, m <sup>2</sup>			<input type="text" value="381.89"/>				(31)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Low  (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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# SAP WorkSheet: New dwelling design stage



(38)m=	86.97	86.37	85.78	83	82.48	80.07	80.07	79.62	81	82.48	83.53	84.63	(38)
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Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	220.73	220.12	219.53	216.76	216.24	213.83	213.83	213.38	214.76	216.24	217.29	218.39	
Average = Sum(39) <sub>1...12</sub> / 12 =												216.76	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.28	1.28	1.27	1.27	1.26	1.27	1.28	1.29	1.29	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.28	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.96 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 104.52 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	114.98	110.8	106.61	102.43	98.25	94.07	94.07	98.25	102.43	106.61	110.8	114.98	
Total = Sum(44) <sub>1...12</sub> =												1254.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	170.51	149.13	153.89	134.16	128.73	111.08	102.94	118.12	119.53	139.3	152.06	165.13	
Total = Sum(45) <sub>1...12</sub> =												1644.57	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.58	22.37	23.08	20.12	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 210 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.01 (51)

If community heating see section 4.3

Volume factor from Table 2a 0.83 (52)

Temperature factor from Table 2b 0.54 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0.97 (54)

Enter (50) or (54) in (55) 0.97 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	30.01	27.11	30.01	29.05	30.01	29.05	30.01	30.01	29.05	30.01	29.05	30.01	(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	30.01	27.11	30.01	29.05	30.01	29.05	30.01	30.01	29.05	30.01	29.05	30.01	(57)
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# SAP WorkSheet: New dwelling design stage



Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
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 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (63)

Output from water heater

(64)m= 

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
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Output from water heater (annual)<sub>1...12</sub> 2271.85 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

99.31	88.08	93.79	85.85	85.42	78.18	76.85	81.9	80.99	88.94	91.81	97.53
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 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 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)m=	177.66	177.66	177.66	177.66	177.66	177.66	177.66	177.66	177.66	177.66	177.66	177.66

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

75.86	67.38	54.8	41.48	31.01	26.18	28.29	36.77	49.35	62.66	73.14	77.97
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

508.01	513.28	499.99	471.71	436.02	402.46	380.05	374.78	388.06	416.34	452.04	485.59
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

55.73	55.73	55.73	55.73	55.73	55.73	55.73	55.73	55.73	55.73	55.73	55.73
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m= 

133.49	131.07	126.06	119.24	114.82	108.59	103.29	110.07	112.49	119.54	127.51	131.08
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

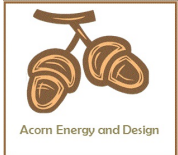
835.3	829.68	798.8	750.39	699.79	655.18	629.57	639.57	667.85	716.49	770.63	812.59
-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (73)

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>o</sub> Table 6b	FF Table 6c	Gains (W)						
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>61.42</td></tr></table> (74)	61.42
0.77												
18.9												
10.63												
0.63												
0.7												
61.42												
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>20.32</td></tr></table>	20.32	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>117.38</td></tr></table> (74)	117.38
0.77												
18.9												
20.32												
0.63												
0.7												
117.38												



## SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	18.9	x	34.53	x	0.63	x	0.7	=	199.45	(74)
North	0.9x	0.77	x	18.9	x	55.46	x	0.63	x	0.7	=	320.37	(74)
North	0.9x	0.77	x	18.9	x	74.72	x	0.63	x	0.7	=	431.56	(74)
North	0.9x	0.77	x	18.9	x	79.99	x	0.63	x	0.7	=	462	(74)
North	0.9x	0.77	x	18.9	x	74.68	x	0.63	x	0.7	=	431.34	(74)
North	0.9x	0.77	x	18.9	x	59.25	x	0.63	x	0.7	=	342.21	(74)
North	0.9x	0.77	x	18.9	x	41.52	x	0.63	x	0.7	=	239.8	(74)
North	0.9x	0.77	x	18.9	x	24.19	x	0.63	x	0.7	=	139.72	(74)
North	0.9x	0.77	x	18.9	x	13.12	x	0.63	x	0.7	=	75.77	(74)
North	0.9x	0.77	x	18.9	x	8.86	x	0.63	x	0.7	=	51.2	(74)
East	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(76)
East	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(76)
East	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(76)
East	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(76)
East	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(76)
East	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(76)
East	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(76)
East	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(76)
East	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(76)
East	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(76)
East	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(76)
South	0.9x	0.77	x	19.53	x	46.75	x	0.63	x	0.7	=	279.05	(78)
South	0.9x	0.77	x	19.53	x	76.57	x	0.63	x	0.7	=	457	(78)
South	0.9x	0.77	x	19.53	x	97.53	x	0.63	x	0.7	=	582.14	(78)
South	0.9x	0.77	x	19.53	x	110.23	x	0.63	x	0.7	=	657.95	(78)
South	0.9x	0.77	x	19.53	x	114.87	x	0.63	x	0.7	=	685.62	(78)
South	0.9x	0.77	x	19.53	x	110.55	x	0.63	x	0.7	=	659.82	(78)
South	0.9x	0.77	x	19.53	x	108.01	x	0.63	x	0.7	=	644.68	(78)
South	0.9x	0.77	x	19.53	x	104.89	x	0.63	x	0.7	=	626.08	(78)
South	0.9x	0.77	x	19.53	x	101.89	x	0.63	x	0.7	=	608.12	(78)
South	0.9x	0.77	x	19.53	x	82.59	x	0.63	x	0.7	=	492.92	(78)
South	0.9x	0.77	x	19.53	x	55.42	x	0.63	x	0.7	=	330.76	(78)
South	0.9x	0.77	x	19.53	x	40.4	x	0.63	x	0.7	=	241.12	(78)
West	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(80)
West	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(80)
West	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(80)
West	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(80)
West	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(80)
West	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(80)
West	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(80)

## SAP WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(80)
West	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(80)
West	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(80)
West	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m ... (82)m

(83)m=	355.59	603.97	830.32	1049.38	1204.28	1210.98	1160.9	1041.2	904.59	667.75	425.39	304.76	(83)
--------	--------	--------	--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	1190.89	1433.65	1629.12	1799.77	1904.07	1866.16	1790.48	1680.77	1572.44	1384.25	1196.03	1117.35	(84)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

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

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.93	0.89	0.83	0.73	0.59	0.47	0.51	0.69	0.86	0.93	0.96	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.97	19.22	19.59	20.03	20.42	20.69	20.81	20.79	20.59	20.08	19.45	18.93	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.86	19.87	19.87	19.87	19.86	19.86	19.85	19.85	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.92	0.88	0.8	0.68	0.52	0.37	0.41	0.62	0.83	0.92	0.95	(89)
--------	------	------	------	-----	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.14	17.5	18.02	18.65	19.18	19.53	19.66	19.65	19.41	18.74	17.84	17.08	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.44	17.79	18.28	18.88	19.38	19.73	19.85	19.84	19.61	18.96	18.11	17.39	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.44	17.79	18.28	18.88	19.38	19.73	19.85	19.84	19.61	18.96	18.11	17.39	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.93	0.9	0.85	0.77	0.66	0.51	0.36	0.4	0.6	0.8	0.9	0.94	(94)
--------	------	-----	------	------	------	------	------	-----	-----	-----	-----	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	1105.14	1283.14	1381.63	1388.65	1256.85	951.15	652.08	676.46	950.28	1103.77	1074.51	1046.2	(95)
--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	2900.77	2836.98	2586.19	2163.97	1661.69	1096.16	695.09	733.11	1182.93	1808.66	2391.73	2880.25	(97)
--------	---------	---------	---------	---------	---------	---------	--------	--------	---------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1335.95	1044.18	896.2	558.23	301.21	0	0	0	0	524.44	948.4	1364.53	
--------	---------	---------	-------	--------	--------	---	---	---	---	--------	-------	---------	--

Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> = 6973.13 (98)

Space heating requirement in kWh/m<sup>2</sup>/year 41.3 (99)

## SAP WorkSheet: New dwelling design stage

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

#### Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1	(202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

1335.95	1044.18	896.2	558.23	301.21	0	0	0	0	524.44	948.4	1364.53
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$(211)_m = \{ [(98)_m \times (204)] \} \times 100 \div (206)$  (211)

1469.69	1148.71	985.92	614.11	331.36	0	0	0	0	576.94	1043.34	1501.13
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Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> = 7671.21 (211)

Space heating fuel (secondary), kWh/month

$= \{ [(98)_m \times (201)] \} \times 100 \div (208)$

(215)<sub>m</sub> =

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Total (kWh/year) = Sum(215)<sub>1...5,10...12</sub> = 0 (215)

#### Water heating

Output from water heater (calculated above)

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
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Efficiency of water heater 80.8 (216)

(217)<sub>m</sub> = 89.3 89.13 88.82 88.15 86.81 80.8 80.8 80.8 80.8 87.95 88.94 89.36 (217)

Fuel for water heating, kWh/month

$(219)_m = (64)_m \times 100 \div (217)_m$

(219)<sub>m</sub> =

250.6	221.3	233.25	210.69	209.65	201.29	193.33	212.12	211.74	218.97	228.95	244.41
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Total = Sum(219a)<sub>1...12</sub> = 2636.31 (219)

#### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		7671.21
Water heating fuel used		2636.31

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 535.88 (232)

Electricity generated by PVs -865.93 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 10133.27 (338)

### 10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) ×	7.6	× 0.01 = 583.01 (240)
Space heating - main system 2	(213) ×	0	× 0.01 = 0 (241)

# SAP WorkSheet: New dwelling design stage



Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	7.6	x 0.01 =	200.36	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a)					
Energy for lighting	(232)	13.19	x 0.01 =	70.68	(250)
Additional standing charges (Table 12)				70	(251)
	one of (233) to (235) x	13.19	x 0.01 =	-114.22	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
<b>Total energy cost</b>	(245)...(247) + (250)...(254) =			819.73	(255)

## 11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	$[(255) \times (256)] \div [(4) + 45.0] =$	1.61	(257)
<b>SAP rating (Section 12)</b>		77.54	(258)

## 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.241	= 1848.76 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.241	= 635.35 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2484.11 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 38.93 (267)
Electricity for lighting	(232) x	0.519	= 278.12 (268)
Energy saving/generation technologies			
Item 1		0.519	= -449.42 (269)
Total CO2, kg/year		sum of (265)...(271) =	2351.74 (272)
<b>CO2 emissions per m²</b>		(272) ÷ (4) =	13.93 (273)
El rating (section 14)			85 (274)

## 13a. Primary Energy

	Energy kWh/year	Primary factor	P. Energy kWh/year
Space heating (main system 1)	(211) x	1.09	= 8361.62 (261)
Space heating (secondary)	(215) x	3.07	= 0 (263)
Energy for water heating	(219) x	1.09	= 2873.58 (264)
Space and water heating	(261) + (262) + (263) + (264) =		11235.2 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	= 230.25 (267)
Electricity for lighting	(232) x	0	= 1645.15 (268)

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Energy saving/generation technologies

Item 1

3.07

=

-2658.39 (269)

'Total Primary Energy

sum of (265)...(271) =

10452.21 (272)

**Primary energy kWh/m<sup>2</sup>/year**

(272) ÷ (4) =

61.91 (273)



# TFEE WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	Chris Mcdonald	<b>Stroma Number:</b>	STRO007579
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.33

Property Address: Phase 2 Plot 2 LPG

**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

1. Overall dwelling dimensions:			
	<b>Area(m<sup>2</sup>)</b>	<b>Av. Height(m)</b>	<b>Volume(m<sup>3</sup>)</b>
Ground floor	90.19 (1a)	2.7 (2a)	243.51 (3a)
First floor	78.65 (1b)	2.41 (2b)	189.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	168.84 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	433.06 (5)

2. Ventilation rate:					
	<b>main heating</b>	<b>secondary heating</b>	<b>other</b>	<b>total</b>	<b>m<sup>3</sup> per hour</b>
Number of chimneys	0	+	0	+	0
Number of open flues	0	+	0	+	0
Number of intermittent fans				4	40 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

					<b>Air changes per hour</b>
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.09	(8)	
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>					
Number of storeys in the dwelling (ns)			0	(9)	
Additional infiltration		[(9)-1]x0.1 =	0	(10)	
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)	
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>					
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)	
If no draught lobby, enter 0.05, else enter 0			0	(13)	
Percentage of windows and doors draught stripped			0	(14)	
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)	
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)	
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)	
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.34	(18)	
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>					
Number of sides sheltered			0	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =		1	(20)	
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34	(21)	

Infiltration rate modified for monthly wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

# TFEE WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4
------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
---------	-----	------	------	------	------	------	------	------	------	------	------	------	-------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)
--------	-----	------	------	------	------	------	------	------	------	------	------	------	------

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

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,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
Windows Type 1			19.53	x1/[1/( 1.4 )+ 0.04] =	25.89		(27)
Windows Type 2			1.26	x1/[1/( 1.4 )+ 0.04] =	1.67		(27)
Windows Type 3			18.9	x1/[1/( 1.4 )+ 0.04] =	25.06		(27)
Windows Type 4			1.26	x1/[1/( 1.4 )+ 0.04] =	1.67		(27)
Floor			90.91	x 0.13 =	11.8183		(28)
Walls	200.79	40.95	159.84	x 0.18 =	28.77		(29)
Roof	90.19	0	90.19	x 0.13 =	11.72		(30)
Total area of elements, m <sup>2</sup>			381.89				(31)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 106.6 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12250.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 16.43 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 123.03 (37)

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

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



# TFEE WorkSheet: New dwelling design stage

(38)m=	85.07	84.54	84.02	81.59	81.13	79.01	79.01	78.62	79.83	81.13	82.06	83.02	(38)
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Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	208.1	207.58	207.06	204.62	204.17	202.05	202.05	201.65	202.86	204.17	205.09	206.05	
Average = Sum(39) <sub>1...12</sub> / 12 =												204.62	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.19	1.2	1.21	1.21	1.22	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.21	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 2.96 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 104.52 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	114.98	110.8	106.61	102.43	98.25	94.07	94.07	98.25	102.43	106.61	110.8	114.98	
Total = Sum(44) <sub>1...12</sub> =												1254.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	170.51	149.13	153.89	134.16	128.73	111.08	102.94	118.12	119.53	139.3	152.06	165.13	
Total = Sum(45) <sub>1...12</sub> =												1644.57	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)
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# TFEE WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

144.93	126.76	130.8	114.04	109.42	94.42	87.5	100.4	101.6	118.41	129.25	140.36
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 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

144.93	126.76	130.8	114.04	109.42	94.42	87.5	100.4	101.6	118.41	129.25	140.36
--------	--------	-------	--------	--------	-------	------	-------	-------	--------	--------	--------

Output from water heater (annual)<sub>1...12</sub> 1397.89 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

36.23	31.69	32.7	28.51	27.36	23.61	21.87	25.1	25.4	29.6	32.31	35.09
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 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 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)m=	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

30.34	26.95	21.92	16.59	12.4	10.47	11.32	14.71	19.74	25.07	29.26	31.19
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 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

340.36	343.9	335	316.05	292.13	269.65	254.63	251.1	260	278.95	302.87	325.35
--------	-------	-----	--------	--------	--------	--------	-------	-----	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m= 

48.7	47.16	43.95	39.6	36.77	32.79	29.4	33.74	35.28	39.79	44.88	47.16
------	-------	-------	------	-------	-------	------	-------	-------	-------	-------	-------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

486.82	485.42	468.28	439.65	408.72	380.32	362.76	366.96	382.44	411.22	444.42	471.11
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 (73)

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>-</sub> Table 6b	FF Table 6c	Gains (W)
North	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">18.9</span>	x <span style="border: 1px solid black; padding: 2px 10px;">10.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">61.42</span> (74)
North	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">18.9</span>	x <span style="border: 1px solid black; padding: 2px 10px;">20.32</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">117.38</span> (74)



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North	0.9x	0.77	x	18.9	x	34.53	x	0.63	x	0.7	=	199.45	(74)
North	0.9x	0.77	x	18.9	x	55.46	x	0.63	x	0.7	=	320.37	(74)
North	0.9x	0.77	x	18.9	x	74.72	x	0.63	x	0.7	=	431.56	(74)
North	0.9x	0.77	x	18.9	x	79.99	x	0.63	x	0.7	=	462	(74)
North	0.9x	0.77	x	18.9	x	74.68	x	0.63	x	0.7	=	431.34	(74)
North	0.9x	0.77	x	18.9	x	59.25	x	0.63	x	0.7	=	342.21	(74)
North	0.9x	0.77	x	18.9	x	41.52	x	0.63	x	0.7	=	239.8	(74)
North	0.9x	0.77	x	18.9	x	24.19	x	0.63	x	0.7	=	139.72	(74)
North	0.9x	0.77	x	18.9	x	13.12	x	0.63	x	0.7	=	75.77	(74)
North	0.9x	0.77	x	18.9	x	8.86	x	0.63	x	0.7	=	51.2	(74)
East	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(76)
East	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(76)
East	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(76)
East	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(76)
East	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(76)
East	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(76)
East	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(76)
East	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(76)
East	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(76)
East	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(76)
East	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(76)
South	0.9x	0.77	x	19.53	x	46.75	x	0.63	x	0.7	=	279.05	(78)
South	0.9x	0.77	x	19.53	x	76.57	x	0.63	x	0.7	=	457	(78)
South	0.9x	0.77	x	19.53	x	97.53	x	0.63	x	0.7	=	582.14	(78)
South	0.9x	0.77	x	19.53	x	110.23	x	0.63	x	0.7	=	657.95	(78)
South	0.9x	0.77	x	19.53	x	114.87	x	0.63	x	0.7	=	685.62	(78)
South	0.9x	0.77	x	19.53	x	110.55	x	0.63	x	0.7	=	659.82	(78)
South	0.9x	0.77	x	19.53	x	108.01	x	0.63	x	0.7	=	644.68	(78)
South	0.9x	0.77	x	19.53	x	104.89	x	0.63	x	0.7	=	626.08	(78)
South	0.9x	0.77	x	19.53	x	101.89	x	0.63	x	0.7	=	608.12	(78)
South	0.9x	0.77	x	19.53	x	82.59	x	0.63	x	0.7	=	492.92	(78)
South	0.9x	0.77	x	19.53	x	55.42	x	0.63	x	0.7	=	330.76	(78)
South	0.9x	0.77	x	19.53	x	40.4	x	0.63	x	0.7	=	241.12	(78)
West	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(80)
West	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(80)
West	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(80)
West	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(80)
West	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(80)
West	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(80)
West	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(80)

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West	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(80)
West	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(80)
West	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(80)
West	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	355.59	603.97	830.32	1049.38	1204.28	1210.98	1160.9	1041.2	904.59	667.75	425.39	304.76	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	842.41	1089.39	1298.6	1489.04	1613	1591.3	1523.67	1408.16	1287.03	1078.97	869.81	775.87	(84)
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### 7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.89	0.73	0.57	0.63	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.76	20.06	20.43	20.74	20.93	20.98	20.98	20.84	20.41	19.91	19.52	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)
--------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.95	0.84	0.64	0.44	0.5	0.79	0.97	1	1	(89)
--------	---	---	------	------	------	------	------	-----	------	------	---	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.58	18.78	19.08	19.45	19.74	19.89	19.92	19.92	19.83	19.44	18.94	18.55	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.74	18.95	19.24	19.61	19.91	20.06	20.1	20.09	20	19.6	19.1	18.71	(92)
--------	-------	-------	-------	-------	-------	-------	------	-------	----	------	------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.74	18.95	19.24	19.61	19.91	20.06	20.1	20.09	20	19.6	19.1	18.71	(93)
--------	-------	-------	-------	-------	-------	-------	------	-------	----	------	------	-------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.84	0.65	0.46	0.52	0.8	0.97	1	1	(94)
--------	---	------	------	------	------	------	------	------	-----	------	---	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	840.98	1083.11	1275.88	1406.24	1360.98	1039.37	697.23	728.63	1026.43	1043.36	866.03	774.98	(95)
--------	--------	---------	---------	---------	---------	---------	--------	--------	---------	---------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	3004.91	2915.78	2638.24	2191.77	1675.38	1103.9	706.3	744.72	1196.36	1838.33	2461.4	2990.6	(97)
--------	---------	---------	---------	---------	---------	--------	-------	--------	---------	---------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1609.96	1231.55	1013.6	565.59	233.91	0	0	0	0	591.45	1148.67	1648.42	
--------	---------	---------	--------	--------	--------	---	---	---	---	--------	---------	---------	--

Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =

8043.15 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

47.64 (99)

## TFEE WorkSheet: New dwelling design stage

### 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
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	1899.25	1495.15	1532.58	0	0	0	0	(100)
---------	---	---	---	---	---	---------	---------	---------	---	---	---	---	-------

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.85	0.91	0.88	0	0	0	0	(101)
---------	---	---	---	---	---	------	------	------	---	---	---	---	-------

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	1611.93	1365.77	1356.27	0	0	0	0	(102)
---------	---	---	---	---	---	---------	---------	---------	---	---	---	---	-------

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	1991.81	1909.59	1777.22	0	0	0	0	(103)
---------	---	---	---	---	---	---------	---------	---------	---	---	---	---	-------

Space cooling requirement for month, whole dwelling, continuous ( kWh) =  $0.024 \times [(103)m - (102)m] \times (41)m$   
 set (104)m to zero if (104)m < 3 x (98)m

(104)m=	0	0	0	0	0	273.51	404.6	313.19	0	0	0	0	(104)
---------	---	---	---	---	---	--------	-------	--------	---	---	---	---	-------

Total = Sum(104) = 991.3 (104)

Cooled fraction

f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	(106)
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Total = Sum(106) = 0 (106)

Space cooling requirement for month = (104)m x (105) x (106)m

(107)m=	0	0	0	0	0	68.38	101.15	78.3	0	0	0	0	(107)
---------	---	---	---	---	---	-------	--------	------	---	---	---	---	-------

Total = Sum(107) = 247.83 (107)

Space cooling requirement in kWh/m<sup>2</sup>/year

(107) ÷ (4) = 1.47 (108)

### 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 49.11 (109)

**Target Fabric Energy Efficiency (TFEE)** 56.47 (109)

# DFEE WorkSheet: New dwelling design stage



## User Details:

<b>Assessor Name:</b>	Chris Mcdonald	<b>Stroma Number:</b>	STRO007579
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.33

## Property Address: Phase 2 Plot 2 LPG

**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

## 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	90.19	(1a) x	2.7	(2a) =	243.51 (3a)
First floor	78.65	(1b) x	2.41	(2b) =	189.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	168.84	(4)			
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =				433.06 (5)

## 2. Ventilation rate:

	main heating		secondary heating		other		total		m <sup>3</sup> per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							4	x 10 =	40 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.09 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration	[(9)-1]x0.1 =		0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)	
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.34 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=

5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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# DFEE WorkSheet: New dwelling design stage



Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4
------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)
--------	-----	------	------	------	------	------	------	------	------	------	------	------	------

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

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,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
Windows Type 1			19.53	x1/[1/( 1.4 )+ 0.04] =	25.89		(27)
Windows Type 2			1.26	x1/[1/( 1.4 )+ 0.04] =	1.67		(27)
Windows Type 3			18.9	x1/[1/( 1.4 )+ 0.04] =	25.06		(27)
Windows Type 4			1.26	x1/[1/( 1.4 )+ 0.04] =	1.67		(27)
Floor			90.91	x 0.14 =	12.7274		(28)
Walls	200.79	40.95	159.84	x 0.16 =	25.57		(29)
Roof	90.19	0	90.19	x 0.1 =	9.02		(30)
Total area of elements, m <sup>2</sup>			381.89				(31)

\* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 101.61 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12250.37 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Low 100 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 32.15 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 133.76 (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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# DFEE WorkSheet: New dwelling design stage



(38)m=	85.07	84.54	84.02	81.59	81.13	79.01	79.01	78.62	79.83	81.13	82.06	83.02	(38)
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Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	218.83	218.3	217.78	215.35	214.89	212.77	212.77	212.38	213.59	214.89	215.81	216.78		
Average = Sum(39) <sub>1...12</sub> / 12 =												215.35	(39)	

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.3	1.29	1.29	1.28	1.27	1.26	1.26	1.26	1.27	1.27	1.28	1.28		
Average = Sum(40) <sub>1...12</sub> / 12 =												1.28	(40)	

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.96 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 104.52 (43)  
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	114.98	110.8	106.61	102.43	98.25	94.07	94.07	98.25	102.43	106.61	110.8	114.98		
Total = Sum(44) <sub>1...12</sub> =												1254.29	(44)	

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	170.51	149.13	153.89	134.16	128.73	111.08	102.94	118.12	119.53	139.3	152.06	165.13		
Total = Sum(45) <sub>1...12</sub> =												1644.57	(45)	

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)
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# DFEE WorkSheet: New dwelling design stage



Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
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 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

144.93	126.76	130.8	114.04	109.42	94.42	87.5	100.4	101.6	118.41	129.25	140.36
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 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0	0
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 (63)

Output from water heater

(64)m= 

144.93	126.76	130.8	114.04	109.42	94.42	87.5	100.4	101.6	118.41	129.25	140.36
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Output from water heater (annual)<sub>1...12</sub> 1397.89 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m= 

36.23	31.69	32.7	28.51	27.36	23.61	21.87	25.1	25.4	29.6	32.31	35.09
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 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 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)m=	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

30.34	26.95	21.92	16.59	12.4	10.47	11.32	14.71	19.74	25.07	29.26	31.19
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 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

340.36	343.9	335	316.05	292.13	269.65	254.63	251.1	260	278.95	302.87	325.35
--------	-------	-----	--------	--------	--------	--------	-------	-----	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

0	0	0	0	0	0	0	0	0	0	0	0
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 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44
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 (71)

Water heating gains (Table 5)

(72)m= 

48.7	47.16	43.95	39.6	36.77	32.79	29.4	33.74	35.28	39.79	44.88	47.16
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 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

486.82	485.42	468.28	439.65	408.72	380.32	362.76	366.96	382.44	411.22	444.42	471.11
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 (73)

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>o</sub> Table 6b	FF Table 6c	Gains (W)
North	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">18.9</span>	x <span style="border: 1px solid black; padding: 2px 10px;">10.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">61.42</span> (74)
North	0.9x <span style="border: 1px solid black; padding: 2px 10px;">0.77</span>	x <span style="border: 1px solid black; padding: 2px 10px;">18.9</span>	x <span style="border: 1px solid black; padding: 2px 10px;">20.32</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.63</span>	x <span style="border: 1px solid black; padding: 2px 10px;">0.7</span>	= <span style="border: 1px solid black; padding: 2px 10px;">117.38</span> (74)



# DFEE WorkSheet: New dwelling design stage

North	0.9x	0.77	x	18.9	x	34.53	x	0.63	x	0.7	=	199.45	(74)
North	0.9x	0.77	x	18.9	x	55.46	x	0.63	x	0.7	=	320.37	(74)
North	0.9x	0.77	x	18.9	x	74.72	x	0.63	x	0.7	=	431.56	(74)
North	0.9x	0.77	x	18.9	x	79.99	x	0.63	x	0.7	=	462	(74)
North	0.9x	0.77	x	18.9	x	74.68	x	0.63	x	0.7	=	431.34	(74)
North	0.9x	0.77	x	18.9	x	59.25	x	0.63	x	0.7	=	342.21	(74)
North	0.9x	0.77	x	18.9	x	41.52	x	0.63	x	0.7	=	239.8	(74)
North	0.9x	0.77	x	18.9	x	24.19	x	0.63	x	0.7	=	139.72	(74)
North	0.9x	0.77	x	18.9	x	13.12	x	0.63	x	0.7	=	75.77	(74)
North	0.9x	0.77	x	18.9	x	8.86	x	0.63	x	0.7	=	51.2	(74)
East	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(76)
East	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(76)
East	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(76)
East	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(76)
East	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(76)
East	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(76)
East	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(76)
East	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(76)
East	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(76)
East	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(76)
East	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(76)
South	0.9x	0.77	x	19.53	x	46.75	x	0.63	x	0.7	=	279.05	(78)
South	0.9x	0.77	x	19.53	x	76.57	x	0.63	x	0.7	=	457	(78)
South	0.9x	0.77	x	19.53	x	97.53	x	0.63	x	0.7	=	582.14	(78)
South	0.9x	0.77	x	19.53	x	110.23	x	0.63	x	0.7	=	657.95	(78)
South	0.9x	0.77	x	19.53	x	114.87	x	0.63	x	0.7	=	685.62	(78)
South	0.9x	0.77	x	19.53	x	110.55	x	0.63	x	0.7	=	659.82	(78)
South	0.9x	0.77	x	19.53	x	108.01	x	0.63	x	0.7	=	644.68	(78)
South	0.9x	0.77	x	19.53	x	104.89	x	0.63	x	0.7	=	626.08	(78)
South	0.9x	0.77	x	19.53	x	101.89	x	0.63	x	0.7	=	608.12	(78)
South	0.9x	0.77	x	19.53	x	82.59	x	0.63	x	0.7	=	492.92	(78)
South	0.9x	0.77	x	19.53	x	55.42	x	0.63	x	0.7	=	330.76	(78)
South	0.9x	0.77	x	19.53	x	40.4	x	0.63	x	0.7	=	241.12	(78)
West	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(80)
West	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(80)
West	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(80)
West	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(80)
West	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(80)
West	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(80)
West	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(80)

## DFEE WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(80)
West	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(80)
West	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(80)
West	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	355.59	603.97	830.32	1049.38	1204.28	1210.98	1160.9	1041.2	904.59	667.75	425.39	304.76	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	842.41	1089.39	1298.6	1489.04	1613	1591.3	1523.67	1408.16	1287.03	1078.97	869.81	775.87	(84)
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### 7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.96	0.93	0.87	0.78	0.65	0.53	0.57	0.76	0.91	0.97	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.15	18.51	19.03	19.68	20.25	20.67	20.86	20.83	20.49	19.72	18.81	18.09	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.85	19.85	19.86	19.86	19.87	19.87	19.87	19.87	19.86	19.86	19.85	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.92	0.85	0.74	0.58	0.42	0.47	0.7	0.88	0.96	0.98	(89)
--------	------	------	------	------	------	------	------	------	-----	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.24	17.6	18.12	18.75	19.29	19.67	19.81	19.79	19.53	18.81	17.91	17.19	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.39	17.75	18.27	18.9	19.45	19.84	19.99	19.96	19.69	18.96	18.06	17.34	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.39	17.75	18.27	18.9	19.45	19.84	19.99	19.96	19.69	18.96	18.06	17.34	(93)
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### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.96	0.94	0.9	0.83	0.72	0.58	0.43	0.48	0.68	0.86	0.94	0.97	(94)
--------	------	------	-----	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	811.54	1019.96	1163.21	1231.03	1164.48	918.95	656.09	671.7	880.2	930.19	820.8	752.04	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	2865.55	2805.97	2562.95	2154.33	1665.88	1114.15	720.69	757.08	1193.14	1796.92	2365.8	2848.25	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1528.18	1200.2	1041.41	664.78	373.04	0	0	0	0	644.85	1112.4	1559.58	
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =

8124.44 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

48.12 (99)

# DFEE WorkSheet: New dwelling design stage



## 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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Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

<b>(100)m=</b>	0	0	0	0	0	2000.06	1574.51	1614.08	0	0	0	0	<b>(100)</b>
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Utilisation factor for loss hm

<b>(101)m=</b>	0	0	0	0	0	0.71	0.78	0.75	0	0	0	0	<b>(101)</b>
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Useful loss, hmLm (Watts) = (100)m x (101)m

<b>(102)m=</b>	0	0	0	0	0	1420.64	1222.94	1203.14	0	0	0	0	<b>(102)</b>
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Gains (solar gains calculated for applicable weather region, see Table 10)

<b>(103)m=</b>	0	0	0	0	0	1991.81	1909.59	1777.22	0	0	0	0	<b>(103)</b>
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Space cooling requirement for month, whole dwelling, continuous ( kWh) = 0.024 x [(103)m – (102)m ] x (41)m  
set (104)m to zero if (104)m < 3 x (98)m

<b>(104)m=</b>	0	0	0	0	0	411.24	510.86	427.11	0	0	0	0	<b>(104)</b>
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Total = Sum(104) =	1349.22	<b>(104)</b>
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Cooled fraction

f C = cooled area ÷ (4) =	1	<b>(105)</b>
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Intermittency factor (Table 10b)

<b>(106)m=</b>	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0	<b>(106)</b>
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Total = Sum(106) =	0	<b>(106)</b>
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Space cooling requirement for month = (104)m x (105) x (106)m

<b>(107)m=</b>	0	0	0	0	0	102.81	127.72	106.78	0	0	0	0	<b>(107)</b>
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Total = Sum(107) =	337.3	<b>(107)</b>
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Space cooling requirement in kWh/m<sup>2</sup>/year

(107) ÷ (4) =	2	<b>(108)</b>
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## 8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency	(99) + (108) =	50.12	<b>(109)</b>
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# DER WorkSheet: New dwelling design stage

## User Details:

<b>Assessor Name:</b>	Chris Mcdonald	<b>Stroma Number:</b>	STRO007579
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.33

## Property Address: Phase 2 Plot 2 LPG

**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

1. Overall dwelling dimensions:			
	Area(m <sup>2</sup> )	Av. Height(m)	Volume(m <sup>3</sup> )
Ground floor	90.19 (1a)	2.7 (2a)	243.51 (3a)
First floor	78.65 (1b)	2.41 (2b)	189.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	168.84 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	433.06 (5)

2. Ventilation rate:						
	main heating	secondary heating	other	total		m <sup>3</sup> per hour
Number of chimneys	0	0	0	0	x 40 =	0 (6a)
Number of open flues	0	0	0	0	x 20 =	0 (6b)
Number of intermittent fans				5	x 10 =	50 (7a)
Number of passive vents				0	x 10 =	0 (7b)
Number of flueless gas fires				0	x 40 =	0 (7c)

Air changes per hour			
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

# DER WorkSheet: New dwelling design stage



Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.4	0.39	0.35	0.35	0.34	0.37	0.39	0.41	0.43
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.6	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59
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### 3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,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
Windows Type 1			<input type="text" value="19.53"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.89"/>		(27)
Windows Type 2			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Windows Type 3			<input type="text" value="18.9"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.06"/>		(27)
Windows Type 4			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Floor			<input type="text" value="90.91"/>	x <input type="text" value="0.14"/>	= <input type="text" value="12.7274"/>	<input type="text"/>	<input type="text"/> (28)
Walls	<input type="text" value="200.79"/>	<input type="text" value="40.95"/>	<input type="text" value="159.84"/>	x <input type="text" value="0.16"/>	= <input type="text" value="25.57"/>	<input type="text"/>	<input type="text"/> (29)
Roof	<input type="text" value="90.19"/>	<input type="text" value="0"/>	<input type="text" value="90.19"/>	x <input type="text" value="0.1"/>	= <input type="text" value="9.02"/>	<input type="text"/>	<input type="text"/> (30)
Total area of elements, m <sup>2</sup>			<input type="text" value="381.89"/>				(31)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Low  (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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# DER WorkSheet: New dwelling design stage

(38)m=	86.97	86.37	85.78	83	82.48	80.07	80.07	79.62	81	82.48	83.53	84.63	(38)
--------	-------	-------	-------	----	-------	-------	-------	-------	----	-------	-------	-------	------

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	220.73	220.12	219.53	216.76	216.24	213.83	213.83	213.38	214.76	216.24	217.29	218.39	
Average = Sum(39) <sub>1...12</sub> / 12 =												216.76	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.31	1.3	1.3	1.28	1.28	1.27	1.27	1.26	1.27	1.28	1.29	1.29	
Average = Sum(40) <sub>1...12</sub> / 12 =												1.28	(40)

Number of days in month (Table 1a)

(41)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(41)
	31	28	31	30	31	30	31	31	30	31	30	31	

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N	2.96	(42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)		
if TFA ≤ 13.9, N = 1		

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	104.52	(43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	114.98	110.8	106.61	102.43	98.25	94.07	94.07	98.25	102.43	106.61	110.8	114.98	
(44)m=	Total = Sum(44) <sub>1...12</sub> =											1254.29	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	170.51	149.13	153.89	134.16	128.73	111.08	102.94	118.12	119.53	139.3	152.06	165.13	
Total = Sum(45) <sub>1...12</sub> =												1644.57	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	25.58	22.37	23.08	20.12	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	210	(47)
---	-----	------

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
---	---	------

Temperature factor from Table 2b	0	(49)
----------------------------------	---	------

Energy lost from water storage, kWh/year <span style="float: right;">(48) x (49) =</span>	210	(50)
---	-----	------

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.01	(51)
--	------	------

If community heating see section 4.3

Volume factor from Table 2a	0.83	(52)
-----------------------------	------	------

Temperature factor from Table 2b	0.54	(53)
----------------------------------	------	------

Energy lost from water storage, kWh/year <span style="float: right;">(47) x (51) x (52) x (53) =</span>	0.97	(54)
---	------	------

Enter (50) or (54) in (55)	0.97	(55)
----------------------------	------	------

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m=	30.01	27.11	30.01	29.05	30.01	29.05	30.01	30.01	29.05	30.01	29.05	30.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	30.01	27.11	30.01	29.05	30.01	29.05	30.01	30.01	29.05	30.01	29.05	30.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

## DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------

Output from water heater (annual)<sub>1...12</sub> 2271.85 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

99.31	88.08	93.79	85.85	85.42	78.18	76.85	81.9	80.99	88.94	91.81	97.53
-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

### 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)m=	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

30.34	26.95	21.92	16.59	12.4	10.47	11.32	14.71	19.74	25.07	29.26	31.19
-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

340.36	343.9	335	316.05	292.13	269.65	254.63	251.1	260	278.95	302.87	325.35
--------	-------	-----	--------	--------	--------	--------	-------	-----	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m= 

133.49	131.07	126.06	119.24	114.82	108.59	103.29	110.07	112.49	119.54	127.51	131.08
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

574.61	572.34	553.39	522.3	489.77	459.12	439.65	446.3	462.64	493.97	530.05	558.03
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------

 (73)

### 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>o</sub> Table 6b	FF Table 6c	Gains (W)						
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>61.42</td></tr></table> (74)	61.42
0.77												
18.9												
10.63												
0.63												
0.7												
61.42												
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>20.32</td></tr></table>	20.32	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>117.38</td></tr></table> (74)	117.38
0.77												
18.9												
20.32												
0.63												
0.7												
117.38												

## DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	18.9	x	34.53	x	0.63	x	0.7	=	199.45	(74)
North	0.9x	0.77	x	18.9	x	55.46	x	0.63	x	0.7	=	320.37	(74)
North	0.9x	0.77	x	18.9	x	74.72	x	0.63	x	0.7	=	431.56	(74)
North	0.9x	0.77	x	18.9	x	79.99	x	0.63	x	0.7	=	462	(74)
North	0.9x	0.77	x	18.9	x	74.68	x	0.63	x	0.7	=	431.34	(74)
North	0.9x	0.77	x	18.9	x	59.25	x	0.63	x	0.7	=	342.21	(74)
North	0.9x	0.77	x	18.9	x	41.52	x	0.63	x	0.7	=	239.8	(74)
North	0.9x	0.77	x	18.9	x	24.19	x	0.63	x	0.7	=	139.72	(74)
North	0.9x	0.77	x	18.9	x	13.12	x	0.63	x	0.7	=	75.77	(74)
North	0.9x	0.77	x	18.9	x	8.86	x	0.63	x	0.7	=	51.2	(74)
East	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(76)
East	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(76)
East	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(76)
East	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(76)
East	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(76)
East	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(76)
East	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(76)
East	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(76)
East	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(76)
East	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(76)
East	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(76)
South	0.9x	0.77	x	19.53	x	46.75	x	0.63	x	0.7	=	279.05	(78)
South	0.9x	0.77	x	19.53	x	76.57	x	0.63	x	0.7	=	457	(78)
South	0.9x	0.77	x	19.53	x	97.53	x	0.63	x	0.7	=	582.14	(78)
South	0.9x	0.77	x	19.53	x	110.23	x	0.63	x	0.7	=	657.95	(78)
South	0.9x	0.77	x	19.53	x	114.87	x	0.63	x	0.7	=	685.62	(78)
South	0.9x	0.77	x	19.53	x	110.55	x	0.63	x	0.7	=	659.82	(78)
South	0.9x	0.77	x	19.53	x	108.01	x	0.63	x	0.7	=	644.68	(78)
South	0.9x	0.77	x	19.53	x	104.89	x	0.63	x	0.7	=	626.08	(78)
South	0.9x	0.77	x	19.53	x	101.89	x	0.63	x	0.7	=	608.12	(78)
South	0.9x	0.77	x	19.53	x	82.59	x	0.63	x	0.7	=	492.92	(78)
South	0.9x	0.77	x	19.53	x	55.42	x	0.63	x	0.7	=	330.76	(78)
South	0.9x	0.77	x	19.53	x	40.4	x	0.63	x	0.7	=	241.12	(78)
West	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(80)
West	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(80)
West	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(80)
West	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(80)
West	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(80)
West	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(80)
West	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(80)

## DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(80)
West	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(80)
West	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(80)
West	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	355.59	603.97	830.32	1049.38	1204.28	1210.98	1160.9	1041.2	904.59	667.75	425.39	304.76	(83)
--------	--------	--------	--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	930.2	1176.3	1383.71	1571.68	1694.05	1670.1	1600.56	1487.5	1367.24	1161.72	955.44	862.79	(84)
--------	-------	--------	---------	---------	---------	--------	---------	--------	---------	---------	--------	--------	------

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

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.97	0.95	0.92	0.86	0.77	0.64	0.51	0.55	0.74	0.89	0.96	0.98	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	18.8	19.06	19.45	19.93	20.35	20.66	20.8	20.77	20.53	19.97	19.3	18.75	(87)
--------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.84	19.84	19.84	19.85	19.86	19.87	19.87	19.87	19.86	19.86	19.85	19.85	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.95	0.91	0.84	0.72	0.56	0.4	0.45	0.67	0.87	0.95	0.97	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	16.89	17.27	17.83	18.52	19.1	19.5	19.65	19.63	19.35	18.59	17.62	16.83	(90)
--------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

(92)m=	17.2	17.57	18.1	18.75	19.31	19.69	19.84	19.82	19.55	18.82	17.9	17.15	(92)
--------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.2	17.57	18.1	18.75	19.31	19.69	19.84	19.82	19.55	18.82	17.9	17.15	(93)
--------	------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

(94)m=	0.95	0.92	0.88	0.81	0.7	0.55	0.4	0.44	0.65	0.84	0.93	0.96	(94)
--------	------	------	------	------	-----	------	-----	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	887.34	1087.52	1219.31	1270.61	1184.57	917.72	639.58	659.3	893.4	976.85	889.14	828.79	(95)
--------	--------	---------	---------	---------	---------	--------	--------	-------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

(97)m=	2848.11	2789.21	2546.35	2135.42	1644.79	1088.78	692.39	729.39	1169.85	1777.8	2346.85	2828.21	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1458.81	1143.54	987.31	622.66	342.4	0	0	0	0	595.9	1049.55	1487.56	(98)
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =

7687.74 (99)

Space heating requirement in kWh/m<sup>2</sup>/year

45.53 (99)



# DER WorkSheet: New dwelling design stage

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

### Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.9	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

1458.81	1143.54	987.31	622.66	342.4	0	0	0	0	595.9	1049.55	1487.56
---------	---------	--------	--------	-------	---	---	---	---	-------	---------	---------

(211)<sub>m</sub> = {[(98)<sub>m</sub> × (204)] } × 100 ÷ (206) (211)

1604.85	1258.02	1086.15	684.99	376.68	0	0	0	0	655.56	1154.62	1636.49
---------	---------	---------	--------	--------	---	---	---	---	--------	---------	---------

Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> = 8457.36 (211)

Space heating fuel (secondary), kWh/month

= {[(98)<sub>m</sub> × (201)] } × 100 ÷ (208)

(215)<sub>m</sub> = 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

Total (kWh/year) = Sum(215)<sub>1...5,10...12</sub> = 0 (215)

### Water heating

Output from water heater (calculated above)

223.78	197.25	207.16	185.72	182.01	162.64	156.21	171.4	171.09	192.58	203.62	218.4
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------

Efficiency of water heater 80.8 (216)

(217)<sub>m</sub> = 

89.41	89.26	88.97	88.36	87.12	80.8	80.8	80.8	80.8	88.21	89.09	89.47
-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

(217)

Fuel for water heating, kWh/month

(219)<sub>m</sub> = (64)<sub>m</sub> × 100 ÷ (217)<sub>m</sub>

(219)<sub>m</sub> = 

250.28	220.98	232.84	210.18	208.91	201.29	193.33	212.12	211.74	218.33	228.55	244.11
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)<sub>1...12</sub> = 2632.67 (219)

### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1		8457.36
Water heating fuel used		2632.67

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 535.88 (232)

Electricity generated by PVs -865.93 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 10915.79 (338)

## 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) ×	0.241	= 2038.22 (261)
Space heating (secondary)	(215) ×	0.519	= 0 (263)



## DER WorkSheet: New dwelling design stage

Water heating	(219) x	0.241	=	634.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2672.7	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	278.12	(268)
Energy saving/generation technologies Item 1		0.519	=	-449.42	(269)
Total CO2, kg/year		sum of (265)...(271) =		2540.33	(272)
<b>Dwelling CO2 Emission Rate</b>		(272) ÷ (4) =		15.05	(273)
El rating (section 14)				84	(274)



# TER WorkSheet: New dwelling design stage

## User Details:

**Assessor Name:** Chris Mcdonald      **Stroma Number:** STRO007579  
**Software Name:** Stroma FSAP 2012      **Software Version:** Version: 1.0.5.33

## Property Address: Phase 2 Plot 2 LPG

**Address :** Land West of Broome Farm Barn, Broome, Craven Arms

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )	Av. Height(m)	Volume(m <sup>3</sup> )
Ground floor	90.19 (1a)	2.7 (2a)	243.51 (3a)
First floor	78.65 (1b)	2.41 (2b)	189.55 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	168.84 (4)		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = 433.06 (5)

### 2. Ventilation rate:

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				4	40 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

### Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.09 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.34 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34 (21)

### Infiltration rate modified for monthly wind speed

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

### Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

# TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.4
--	------	------	------	------	------	------	------	------	------	------	------	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
---------	-----	------	------	------	------	------	------	------	------	------	------	------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
--------	-----	------	------	------	------	------	------	------	------	------	------	------

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

ELEMENT	Gross area (m <sup>2</sup> )	Openings m <sup>2</sup>	Net Area A ,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
Windows Type 1			<input type="text" value="19.53"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.89"/>		(27)
Windows Type 2			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Windows Type 3			<input type="text" value="18.9"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="25.06"/>		(27)
Windows Type 4			<input type="text" value="1.26"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.67"/>		(27)
Floor			<input type="text" value="90.91"/>	x <input type="text" value="0.13"/>	= <input type="text" value="11.8183"/>	<input type="text"/>	<input type="text"/> (28)
Walls	<input type="text" value="200.79"/>	<input type="text" value="40.95"/>	<input type="text" value="159.84"/>	x <input type="text" value="0.18"/>	= <input type="text" value="28.77"/>	<input type="text"/>	<input type="text"/> (29)
Roof	<input type="text" value="90.19"/>	<input type="text" value="0"/>	<input type="text" value="90.19"/>	x <input type="text" value="0.13"/>	= <input type="text" value="11.72"/>	<input type="text"/>	<input type="text"/> (30)
Total area of elements, m <sup>2</sup>			<input type="text" value="381.89"/>				(31)

\* for windows and roof windows, use effective window U-value calculated using formula  $1/[(1/U\text{-value})+0.04]$  as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) =  (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m<sup>2</sup>K Indicative Value: Medium  (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K  (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) =  (37)

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

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

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(38)m= 

85.07	84.54	84.02	81.59	81.13	79.01	79.01	78.62	79.83	81.13	82.06	83.02
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m= 

208.1	207.58	207.06	204.62	204.17	202.05	202.05	201.65	202.86	204.17	205.09	206.05
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Average = Sum(39)<sub>1...12</sub> / 12 = 

204.62
--------

 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m= 

1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.19	1.2	1.21	1.21	1.22
------	------	------	------	------	-----	-----	------	-----	------	------	------

Average = Sum(40)<sub>1...12</sub> / 12 = 

1.21
------

 (40)

Number of days in month (Table 1a)

(41)m= 

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

**4. Water heating energy requirement: kWh/year:**

Assumed occupancy, N 

2.96
------

 (42)  
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)  
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 

104.52
--------

 (43)  
*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)*

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
114.98	110.8	106.61	102.43	98.25	94.07	94.07	98.25	102.43	106.61	110.8	114.98

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m= Total = Sum(44)<sub>1...12</sub> = 

1254.29
---------

 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m= 

170.51	149.13	153.89	134.16	128.73	111.08	102.94	118.12	119.53	139.3	152.06	165.13
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------

Total = Sum(45)<sub>1...12</sub> = 

1644.57
---------

 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m= 

25.58	22.37	23.08	20.12	19.31	16.66	15.44	17.72	17.93	20.9	22.81	24.77
-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------

 (46)

Water storage loss:  
 Storage volume (litres) including any solar or WWHRS storage within same vessel 

150
-----

 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)  
 Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:  
 a) If manufacturer's declared loss factor is known (kWh/day): 

1.7
-----

 (48)

Temperature factor from Table 2b 

0.54
------

 (49)

Energy lost from water storage, kWh/year (48) x (49) = 

0.92
------

 (50)

b) If manufacturer's declared cylinder loss factor is not known:  
 Hot water storage loss factor from Table 2 (kWh/litre/day) 

0
---

 (51)

If community heating see section 4.3  
 Volume factor from Table 2a 

0
---

 (52)

Temperature factor from Table 2b 

0
---

 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 

0
---

 (54)

Enter (50) or (54) in (55) 

0.92
------

 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m= 

28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m= 

28.48	25.73	28.48	27.57	28.48	27.57	28.48	28.48	27.57	28.48	27.57	28.48
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (57)

# TER WorkSheet: New dwelling design stage



Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

222.25	195.87	205.63	184.24	180.48	161.16	154.68	169.87	169.61	191.05	202.14	216.87
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

0	0	0	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---

 (63)

Output from water heater

(64)m= 

222.25	195.87	205.63	184.24	180.48	161.16	154.68	169.87	169.61	191.05	202.14	216.87
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)<sub>1...12</sub> 2253.85 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

98.09	86.98	92.56	84.67	84.2	77	75.62	80.67	79.81	87.72	90.62	96.3
-------	-------	-------	-------	------	----	-------	-------	-------	-------	-------	------

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

## 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)m=	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05	148.05

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

30.34	26.95	21.92	16.59	12.4	10.47	11.32	14.71	19.74	25.07	29.26	31.19
-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

340.36	343.9	335	316.05	292.13	269.65	254.63	251.1	260	278.95	302.87	325.35
--------	-------	-----	--------	--------	--------	--------	-------	-----	--------	--------	--------

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44	-118.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m= 

131.84	129.43	124.41	117.6	113.17	106.94	101.64	108.43	110.84	117.9	125.86	129.44
--------	--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------

 (72)

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m= 

572.97	570.69	551.74	520.66	488.12	457.48	438.01	444.65	461	492.33	528.4	556.39
--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	-------	--------

 (73)

## 6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m <sup>2</sup>	Flux Table 6a	g <sub>g</sub> Table 6b	FF Table 6c	Gains (W)						
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>10.63</td></tr></table>	10.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>61.42</td></tr></table> (74)	61.42
0.77												
18.9												
10.63												
0.63												
0.7												
61.42												
North	0.9x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.77</td></tr></table>	0.77	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>18.9</td></tr></table>	18.9	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>20.32</td></tr></table>	20.32	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.63</td></tr></table>	0.63	x <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>0.7</td></tr></table>	0.7	= <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td>117.38</td></tr></table> (74)	117.38
0.77												
18.9												
20.32												
0.63												
0.7												
117.38												



## TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	18.9	x	34.53	x	0.63	x	0.7	=	199.45	(74)
North	0.9x	0.77	x	18.9	x	55.46	x	0.63	x	0.7	=	320.37	(74)
North	0.9x	0.77	x	18.9	x	74.72	x	0.63	x	0.7	=	431.56	(74)
North	0.9x	0.77	x	18.9	x	79.99	x	0.63	x	0.7	=	462	(74)
North	0.9x	0.77	x	18.9	x	74.68	x	0.63	x	0.7	=	431.34	(74)
North	0.9x	0.77	x	18.9	x	59.25	x	0.63	x	0.7	=	342.21	(74)
North	0.9x	0.77	x	18.9	x	41.52	x	0.63	x	0.7	=	239.8	(74)
North	0.9x	0.77	x	18.9	x	24.19	x	0.63	x	0.7	=	139.72	(74)
North	0.9x	0.77	x	18.9	x	13.12	x	0.63	x	0.7	=	75.77	(74)
North	0.9x	0.77	x	18.9	x	8.86	x	0.63	x	0.7	=	51.2	(74)
East	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(76)
East	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(76)
East	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(76)
East	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(76)
East	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(76)
East	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(76)
East	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(76)
East	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(76)
East	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(76)
East	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(76)
East	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(76)
East	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(76)
South	0.9x	0.77	x	19.53	x	46.75	x	0.63	x	0.7	=	279.05	(78)
South	0.9x	0.77	x	19.53	x	76.57	x	0.63	x	0.7	=	457	(78)
South	0.9x	0.77	x	19.53	x	97.53	x	0.63	x	0.7	=	582.14	(78)
South	0.9x	0.77	x	19.53	x	110.23	x	0.63	x	0.7	=	657.95	(78)
South	0.9x	0.77	x	19.53	x	114.87	x	0.63	x	0.7	=	685.62	(78)
South	0.9x	0.77	x	19.53	x	110.55	x	0.63	x	0.7	=	659.82	(78)
South	0.9x	0.77	x	19.53	x	108.01	x	0.63	x	0.7	=	644.68	(78)
South	0.9x	0.77	x	19.53	x	104.89	x	0.63	x	0.7	=	626.08	(78)
South	0.9x	0.77	x	19.53	x	101.89	x	0.63	x	0.7	=	608.12	(78)
South	0.9x	0.77	x	19.53	x	82.59	x	0.63	x	0.7	=	492.92	(78)
South	0.9x	0.77	x	19.53	x	55.42	x	0.63	x	0.7	=	330.76	(78)
South	0.9x	0.77	x	19.53	x	40.4	x	0.63	x	0.7	=	241.12	(78)
West	0.9x	0.77	x	1.26	x	19.64	x	0.63	x	0.7	=	7.56	(80)
West	0.9x	0.77	x	1.26	x	38.42	x	0.63	x	0.7	=	14.79	(80)
West	0.9x	0.77	x	1.26	x	63.27	x	0.63	x	0.7	=	24.36	(80)
West	0.9x	0.77	x	1.26	x	92.28	x	0.63	x	0.7	=	35.53	(80)
West	0.9x	0.77	x	1.26	x	113.09	x	0.63	x	0.7	=	43.55	(80)
West	0.9x	0.77	x	1.26	x	115.77	x	0.63	x	0.7	=	44.58	(80)
West	0.9x	0.77	x	1.26	x	110.22	x	0.63	x	0.7	=	42.44	(80)

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West	0.9x	0.77	x	1.26	x	94.68	x	0.63	x	0.7	=	36.46	(80)
West	0.9x	0.77	x	1.26	x	73.59	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.77	x	1.26	x	45.59	x	0.63	x	0.7	=	17.56	(80)
West	0.9x	0.77	x	1.26	x	24.49	x	0.63	x	0.7	=	9.43	(80)
West	0.9x	0.77	x	1.26	x	16.15	x	0.63	x	0.7	=	6.22	(80)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	355.59	603.97	830.32	1049.38	1204.28	1210.98	1160.9	1041.2	904.59	667.75	425.39	304.76	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	928.56	1174.66	1382.07	1570.04	1692.41	1668.46	1598.91	1485.86	1365.59	1160.08	953.79	861.15	(84)
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### 7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.96	0.87	0.71	0.54	0.6	0.84	0.97	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.6	19.81	20.1	20.46	20.77	20.94	20.99	20.98	20.86	20.45	19.96	19.57	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.62	0.42	0.47	0.76	0.96	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.03	18.33	18.76	19.28	19.69	19.88	19.92	19.92	19.81	19.28	18.56	17.99	(90)
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fLA = Living area ÷ (4) =

0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.29	18.58	18.98	19.48	19.87	20.06	20.1	20.09	19.98	19.47	18.79	18.25	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.29	18.58	18.98	19.48	19.87	20.06	20.1	20.09	19.98	19.47	18.79	18.25	(93)
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### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.93	0.82	0.63	0.44	0.49	0.77	0.95	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	925.8	1164.33	1348.81	1461.62	1391.39	1048.29	698.82	731.63	1049.99	1107.72	946.95	859.34	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm , W = [(93)m x ((93)m – (96)m )

(97)m=	2912.2	2839.44	2584.59	2164.83	1667.13	1102.92	706.26	744.65	1193.35	1811.9	2397.38	2896.02	(97)
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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	1477.88	1125.67	919.42	506.31	205.15	0	0	0	0	523.91	1044.31	1515.29	
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =

7317.94 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

43.34 (99)

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

#### Space heating:

Fraction of space heat from secondary/supplementary system	0	(201)
Fraction of space heat from main system(s)	$(202) = 1 - (201) =$	1 (202)
Fraction of total heating from main system 1	$(204) = (202) \times [1 - (203)] =$	1 (204)
Efficiency of main space heating system 1	93.5	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

1477.88	1125.67	919.42	506.31	205.15	0	0	0	0	523.91	1044.31	1515.29
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$(211)_m = \{ [(98)_m \times (204)] \} \times 100 \div (206)$  (211)

1580.63	1203.93	983.34	541.51	219.41	0	0	0	0	560.33	1116.91	1620.63
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$Total (kWh/year) = Sum(211)_{1..5,10..12} =$  7826.68 (211)

Space heating fuel (secondary), kWh/month

$= \{ [(98)_m \times (201)] \} \times 100 \div (208)$

$(215)_m =$

0	0	0	0	0	0	0	0	0	0	0	0
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$Total (kWh/year) = Sum(215)_{1..5,10..12} =$  0 (215)

#### Water heating

Output from water heater (calculated above)

222.25	195.87	205.63	184.24	180.48	161.16	154.68	169.87	169.61	191.05	202.14	216.87
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Efficiency of water heater 79.8 (216)

$(217)_m =$

88.94	88.74	88.34	87.37	85.16	79.8	79.8	79.8	79.8	87.37	88.57	89.01
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(217)

Fuel for water heating, kWh/month

$(219)_m = (64)_m \times 100 \div (217)_m$

$(219)_m =$

249.89	220.73	232.79	210.86	211.94	201.96	193.84	212.87	212.54	218.67	228.21	243.66
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$Total = Sum(219a)_{1..12} =$  2637.95 (219)

#### Annual totals

	<b>kWh/year</b>	<b>kWh/year</b>
Space heating fuel used, main system 1	7826.68	7826.68
Water heating fuel used	2637.95	2637.95

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year  $sum\ of\ (230a)...(230g) =$  75 (231)

Electricity for lighting 535.88 (232)

Total delivered energy for all uses  $(211)...(221) + (231) + (232)...(237b) =$  11155.3 (338)

### 12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	$(211) \times$	=	<span style="border: 1px solid black; padding: 2px;">0.216</span>	=	<span style="border: 1px solid black; padding: 2px;">1690.56</span> (261)
Space heating (secondary)	$(215) \times$	=	<span style="border: 1px solid black; padding: 2px;">0.519</span>	=	<span style="border: 1px solid black; padding: 2px;">0</span> (263)
Water heating	$(219) \times$	=	<span style="border: 1px solid black; padding: 2px;">0.216</span>	=	<span style="border: 1px solid black; padding: 2px;">569.8</span> (264)

# TER WorkSheet: New dwelling design stage



Space and water heating	(261) + (262) + (263) + (264) =			2260.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	278.12	(268)
Total CO2, kg/year	sum of (265)...(271) =			2577.41	(272)
<b>TER =</b>				16.07	(273)