

# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.17  
Printed on 16 June 2023 at 14:56:07

## Project Information:

**Assessed By:** Ben Talbutt (STRO036639)

**Building Type:** Flat

## Dwelling Details:

**NEW DWELLING DESIGN STAGE**

Total Floor Area: 82.7m<sup>2</sup>

**Site Reference :** Fosters Estate Block D

**Plot Reference:** D1-01

**Address :**

## Client Details:

**Name:**

**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: Electricity (c)

Fuel factor: 1.55 (electricity (c))

Target Carbon Dioxide Emission Rate (TER)

27.69 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER)

11.71 kg/m<sup>2</sup>

OK

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)

57.0 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE)

50.6 kWh/m<sup>2</sup>

OK

## 2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.41 (max. 2.00)	1.48 (max. 3.30)	OK

## 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

## 3 Air permeability

Air permeability at 50 pascals

3.00 (design value)

Maximum

10.0

OK

## 4 Heating efficiency

Main Heating system:

Community heating schemes - Heat pump

Secondary heating system:

None

## 5 Cylinder insulation

Hot water Storage:

No cylinder

## 6 Controls

Space heating controls

Charging system linked to use of community heating, programmer and at least two room thermostats

OK

Hot water controls:

No cylinder thermostat  
No cylinder

# Regulations Compliance Report

## 7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

## 8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	0.61	
Maximum	1.5	OK
MVHR efficiency:	88%	
Minimum	70%	OK

## 9 Summertime temperature

Overheating risk (Thames valley):	Not assessed	?
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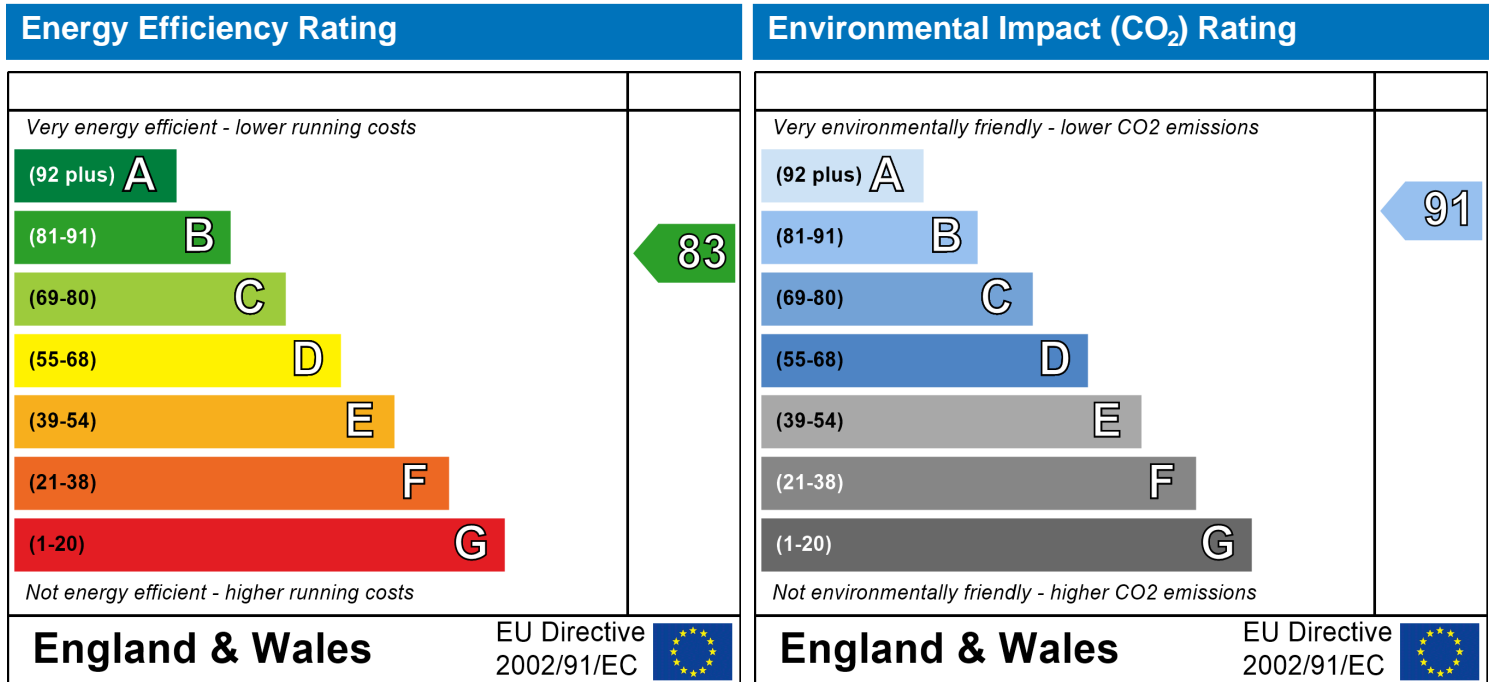
## 10 Key features

Air permeability	3.0 m <sup>3</sup> /m <sup>2</sup> h	
Party Walls U-value	0 W/m <sup>2</sup> K	
Floors U-value	0.1 W/m <sup>2</sup> K	
Community heating, heat from electric heat pump		

Dwelling type: Ground floor Flat  
 Date of assessment: 13 October 2022  
 Produced by: Ben Talbutt  
 Total floor area: 82.7 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: D1-01

Address:  
 Located in: England  
 Region: Thames valley  
 UPRN:  
 Date of assessment: 13 October 2022  
 Date of certificate: 16 June 2023  
 Assessment type: New dwelling design stage  
 Transaction type: New dwelling  
 Tenure type: Unknown  
 Related party disclosure: No related party  
 Thermal Mass Parameter: Indicative Value Medium  
 Water use <= 125 litres/person/day: True  
 PCDF Version: 505

## Property description:

Dwelling type: Flat  
 Detachment:  
 Year Completed: 2022  
 Floor Location: Floor area: Storey height:  
 Floor 0 42.39 m<sup>2</sup> 2.82 m  
 Floor 1 40.31 m<sup>2</sup> 3.15 m  
 Living area: 32.22 m<sup>2</sup> (fraction 0.39)  
 Front of dwelling faces: Unspecified

## Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
Win 1	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 2	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 3	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 4	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 5	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 6	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 7	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	
Win 8	Manufacturer	Windows	low-E, En = 0.05, soft coat	No	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
Front Door	mm	1	0	1.48	2.52	1
Win 1	16mm or more	0.8	0.4	1.4	0.72	1
Win 2	16mm or more	0.8	0.4	1.4	1.61	1
Win 3	16mm or more	0.8	0.4	1.4	2.01	1
Win 4	16mm or more	0.8	0.4	1.4	0.91	1
Win 5	16mm or more	0.8	0.4	1.4	5.95	1
Win 6	16mm or more	0.8	0.4	1.4	1.99	1
Win 7	16mm or more	0.8	0.4	1.4	0.9	1
Win 8	16mm or more	0.8	0.4	1.4	0.9	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		Ext Wall	South East	1.05	2.4
Win 1		Ext Wall	South East	0.3	2.4
Win 2		Ext Wall	South East	1.21	1.33
Win 3		Ext Wall	South East	1.02	1.97
Win 4		Ext Wall	South East	0.46	1.97
Win 5		Ext Wall	North West	2.48	2.4
Win 6		Ext Wall	North West	1.02	1.95

# SAP Input

Win 7	Ext Wall	North West	0.46	1.95
Win 8	Ext Wall	South West	0.46	1.95

Overshading: Average or unknown

## Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
Ext Wall	95.6	17.51	78.09	0.14	0	False	N/A
Concrete Column	12.99	0	12.99	0.2	0	False	N/A
Ground Floor	42.39			0.1			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	56.48						N/A

## Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0813						
	Length	Psi-value					
[Approved]	4.73	0.3	E2	Other lintels (including other steel lintels)			
[Approved]	4.49	0.04	E3	Sill			
[Approved]	36.64	0.05	E4	Jamb			
[Approved]	18.43	0.16	E5	Ground floor (normal)			
[Approved]	18.43	0.07	E7	Party floor between dwellings (in blocks of flats)			
[Approved]	18.43	0.07	E6	Intermediate floor within a dwelling			
[Approved]	11.94	0.09	E16	Corner (normal)			
[Approved]	11.94	0.06	E18	Party wall between dwellings			
	0	0.08	E14	Flat roof			
	0	0.32	E20	Exposed floor (normal)			
[Approved]	0	-0.09	E17	Corner (inverted – internal area greater than external area)			
	9.55	0.16	P1	Ground floor			
	9.55	0	P2	Intermediate floor within a dwelling			
	9.55	0	P3	Intermediate floor between dwellings (in blocks of flats)			
	0	0.24	P8	Exposed floor (inverted)			
	0	0.24	P4	Roof (insulation at ceiling level)			

## Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery
	Number of wet rooms: Kitchen + 1
	Ductwork: Insulation, Rigid
	Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	3

## Main heating system:

Main heating system:	Community heating schemes
	Heat source: Community heat pump
	heat from electric heat pump, heat fraction 1, efficiency 383
	Piping >=1991, pre-insulated, low temp, variable flow

## Main heating Control:

Main heating Control:	Charging system linked to use of community heating, programmer and at least two room thermostats
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# SAP Input

Control code: 2312

## Secondary heating system:

Secondary heating system: None

## Water heating:

Water heating: From main heating system  
Water code: 901  
Fuel :heat from boilers – mains gas  
No hot water cylinder  
Solar panel: False

## Others:

Electricity tariff: Standard Tariff  
In Smoke Control Area: Unknown  
Conservatory: No conservatory  
Low energy lights: 100%  
Terrain type: Low rise urban / suburban  
EPC language: English  
Wind turbine: No  
Photovoltaics: None  
Assess Zero Carbon Home: No

## SAP WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	Ben Talbutt	<b>Stroma Number:</b>	STRO036639
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.17

Property Address: D1-01

### Address :

#### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	42.39	(1a) x	2.82	(2a) =	119.54 (3a)
First floor	40.31	(1b) x	3.15	(2b) =	126.98 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	82.7	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	246.52 (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							0	x 10 =	0 (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) =	0	÷ (5) =	0 (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 Infiltration rate = 0.25 - [0.2 x (14) ÷ 100] =			0 (15)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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			2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =			0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =			0.13 (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

	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

74.8 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)
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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	(24b)
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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	(24c)
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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 x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)
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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
Doors			2.52	x 1.48	= 3.7296		(26)
Windows Type 1			0.72	x 1/[1/(1.4)+0.04]	= 0.95		(27)
Windows Type 2			1.61	x 1/[1/(1.4)+0.04]	= 2.13		(27)
Windows Type 3			2.01	x 1/[1/(1.4)+0.04]	= 2.66		(27)
Windows Type 4			0.91	x 1/[1/(1.4)+0.04]	= 1.21		(27)
Windows Type 5			5.95	x 1/[1/(1.4)+0.04]	= 7.89		(27)
Windows Type 6			1.99	x 1/[1/(1.4)+0.04]	= 2.64		(27)
Windows Type 7			0.9	x 1/[1/(1.4)+0.04]	= 1.19		(27)
Windows Type 8			0.9	x 1/[1/(1.4)+0.04]	= 1.19		(27)
Floor			42.39	x 0.1	= 4.239		(28)
Walls Type1	95.6	17.51	78.09	x 0.14	= 10.93		(29)
Walls Type2	12.99	0	12.99	x 0.2	= 2.6		(29)
Total area of elements, m <sup>2</sup>			150.98				(31)
Party wall			56.48	x 0	= 0		(32)

\* 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) = 41.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (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



# SAP WorkSheet: New dwelling design stage

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 12.28 (36)

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

Total fabric heat loss (33) + (36) = 53.65 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.47	23.22	22.96	21.66	21.4	20.1	20.1	19.84	20.62	21.4	21.92	22.44	(38)

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

(39)m=	77.13	76.87	76.61	75.31	75.05	73.75	73.75	73.5	74.27	75.05	75.57	76.09	
Average = Sum(39) <sub>1...12</sub> / 12 =												75.25	(39)

Heat loss parameter (HLP), W/m<sup>2</sup>K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92	
Average = Sum(40) <sub>1...12</sub> / 12 =												0.91	(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 2.51 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 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 93.86 (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	
(44)m=	103.25	99.49	95.74	91.99	88.23	84.48	84.48	88.23	91.99	95.74	99.49	103.25	
Total = Sum(44) <sub>1...12</sub> =												1126.35	(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=	153.11	133.92	138.19	120.48	115.6	99.75	92.44	106.07	107.34	125.09	136.55	148.28	
Total = Sum(45) <sub>1...12</sub> =												1476.82	(45)

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

(46)m= 

22.97	20.09	20.73	18.07	17.34	14.96	13.87	15.91	16.1	18.76	20.48	22.24
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 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (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) = 110 (50)

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

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

## SAP WorkSheet: New dwelling design stage

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

1.03
1.03

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

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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(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= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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(57)

Primary circuit loss (annual) from Table 3 

0
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(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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 x (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 x (45)m + (46)m + (57)m + (59)m + (61)m  
 (62)m= 

208.39	183.84	193.47	173.97	170.88	153.25	147.71	161.35	160.83	180.37	190.04	203.56
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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 FGHRHS and/or WWHRHS 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= 

208.39	183.84	193.47	173.97	170.88	153.25	147.71	161.35	160.83	180.37	190.04	203.56
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Output from water heater (annual)<sub>1...12</sub>

2127.66
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(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= 

95.13	84.47	90.17	82.85	82.66	75.96	74.96	79.49	78.49	85.81	88.2	93.53
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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
150.73	150.73	150.73	150.73	150.73	150.73	150.73	150.73	150.73	150.73	150.73	150.73

(66)

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

50.33	44.71	36.36	27.53	20.58	17.37	18.77	24.4	32.75	41.58	48.53	51.73
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(67)

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

335.81	339.29	330.51	311.82	288.22	266.04	251.22	247.74	256.52	275.21	298.81	320.99
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

52.58	52.58	52.58	52.58	52.58	52.58	52.58	52.58	52.58	52.58	52.58	52.58
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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= 

-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)  
 (72)m= 

127.87	125.7	121.19	115.07	111.1	105.5	100.75	106.84	109.01	115.34	122.5	125.71
--------	-------	--------	--------	-------	-------	--------	--------	--------	--------	-------	--------

(72)

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

616.83	612.52	590.89	557.24	522.72	491.74	473.57	481.8	501.1	534.96	572.66	601.26
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------

(73)

### 6. Solar gains:

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

# SAP WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)
Southeast 0.9x	0.77	x	0.72	x	36.79	x	0.4	x	0.8	=	5.87 (77)
Southeast 0.9x	0.77	x	1.61	x	36.79	x	0.4	x	0.8	=	13.14 (77)
Southeast 0.9x	0.77	x	2.01	x	36.79	x	0.4	x	0.8	=	16.4 (77)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.4	x	0.8	=	7.43 (77)
Southeast 0.9x	0.77	x	0.72	x	62.67	x	0.4	x	0.8	=	10.01 (77)
Southeast 0.9x	0.77	x	1.61	x	62.67	x	0.4	x	0.8	=	22.38 (77)
Southeast 0.9x	0.77	x	2.01	x	62.67	x	0.4	x	0.8	=	27.94 (77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.4	x	0.8	=	12.65 (77)
Southeast 0.9x	0.77	x	0.72	x	85.75	x	0.4	x	0.8	=	13.69 (77)
Southeast 0.9x	0.77	x	1.61	x	85.75	x	0.4	x	0.8	=	30.62 (77)
Southeast 0.9x	0.77	x	2.01	x	85.75	x	0.4	x	0.8	=	38.22 (77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.4	x	0.8	=	17.31 (77)
Southeast 0.9x	0.77	x	0.72	x	106.25	x	0.4	x	0.8	=	16.96 (77)
Southeast 0.9x	0.77	x	1.61	x	106.25	x	0.4	x	0.8	=	37.94 (77)
Southeast 0.9x	0.77	x	2.01	x	106.25	x	0.4	x	0.8	=	47.36 (77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.4	x	0.8	=	21.44 (77)
Southeast 0.9x	0.77	x	0.72	x	119.01	x	0.4	x	0.8	=	19 (77)
Southeast 0.9x	0.77	x	1.61	x	119.01	x	0.4	x	0.8	=	42.49 (77)
Southeast 0.9x	0.77	x	2.01	x	119.01	x	0.4	x	0.8	=	53.05 (77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.4	x	0.8	=	24.02 (77)
Southeast 0.9x	0.77	x	0.72	x	118.15	x	0.4	x	0.8	=	18.86 (77)
Southeast 0.9x	0.77	x	1.61	x	118.15	x	0.4	x	0.8	=	42.18 (77)
Southeast 0.9x	0.77	x	2.01	x	118.15	x	0.4	x	0.8	=	52.66 (77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.4	x	0.8	=	23.84 (77)
Southeast 0.9x	0.77	x	0.72	x	113.91	x	0.4	x	0.8	=	18.19 (77)
Southeast 0.9x	0.77	x	1.61	x	113.91	x	0.4	x	0.8	=	40.67 (77)
Southeast 0.9x	0.77	x	2.01	x	113.91	x	0.4	x	0.8	=	50.77 (77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.4	x	0.8	=	22.99 (77)
Southeast 0.9x	0.77	x	0.72	x	104.39	x	0.4	x	0.8	=	16.67 (77)
Southeast 0.9x	0.77	x	1.61	x	104.39	x	0.4	x	0.8	=	37.27 (77)
Southeast 0.9x	0.77	x	2.01	x	104.39	x	0.4	x	0.8	=	46.53 (77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.4	x	0.8	=	21.07 (77)
Southeast 0.9x	0.77	x	0.72	x	92.85	x	0.4	x	0.8	=	14.83 (77)
Southeast 0.9x	0.77	x	1.61	x	92.85	x	0.4	x	0.8	=	33.15 (77)
Southeast 0.9x	0.77	x	2.01	x	92.85	x	0.4	x	0.8	=	41.39 (77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.4	x	0.8	=	18.74 (77)
Southeast 0.9x	0.77	x	0.72	x	69.27	x	0.4	x	0.8	=	11.06 (77)
Southeast 0.9x	0.77	x	1.61	x	69.27	x	0.4	x	0.8	=	24.73 (77)
Southeast 0.9x	0.77	x	2.01	x	69.27	x	0.4	x	0.8	=	30.88 (77)

## SAP WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.4	x	0.8	=	13.98	(77)
Southeast 0.9x	0.77	x	0.72	x	44.07	x	0.4	x	0.8	=	7.04	(77)
Southeast 0.9x	0.77	x	1.61	x	44.07	x	0.4	x	0.8	=	15.73	(77)
Southeast 0.9x	0.77	x	2.01	x	44.07	x	0.4	x	0.8	=	19.64	(77)
Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.4	x	0.8	=	8.89	(77)
Southeast 0.9x	0.77	x	0.72	x	31.49	x	0.4	x	0.8	=	5.03	(77)
Southeast 0.9x	0.77	x	1.61	x	31.49	x	0.4	x	0.8	=	11.24	(77)
Southeast 0.9x	0.77	x	2.01	x	31.49	x	0.4	x	0.8	=	14.04	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.4	x	0.8	=	6.35	(77)
Southwest 0.9x	0.77	x	0.9	x	36.79		0.4	x	0.8	=	7.34	(79)
Southwest 0.9x	0.77	x	0.9	x	62.67		0.4	x	0.8	=	12.51	(79)
Southwest 0.9x	0.77	x	0.9	x	85.75		0.4	x	0.8	=	17.11	(79)
Southwest 0.9x	0.77	x	0.9	x	106.25		0.4	x	0.8	=	21.21	(79)
Southwest 0.9x	0.77	x	0.9	x	119.01		0.4	x	0.8	=	23.75	(79)
Southwest 0.9x	0.77	x	0.9	x	118.15		0.4	x	0.8	=	23.58	(79)
Southwest 0.9x	0.77	x	0.9	x	113.91		0.4	x	0.8	=	22.73	(79)
Southwest 0.9x	0.77	x	0.9	x	104.39		0.4	x	0.8	=	20.83	(79)
Southwest 0.9x	0.77	x	0.9	x	92.85		0.4	x	0.8	=	18.53	(79)
Southwest 0.9x	0.77	x	0.9	x	69.27		0.4	x	0.8	=	13.82	(79)
Southwest 0.9x	0.77	x	0.9	x	44.07		0.4	x	0.8	=	8.8	(79)
Southwest 0.9x	0.77	x	0.9	x	31.49		0.4	x	0.8	=	6.28	(79)
Northwest 0.9x	0.77	x	5.95	x	11.28	x	0.4	x	0.8	=	14.89	(81)
Northwest 0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	4.98	(81)
Northwest 0.9x	0.77	x	0.9	x	11.28	x	0.4	x	0.8	=	2.25	(81)
Northwest 0.9x	0.77	x	5.95	x	22.97	x	0.4	x	0.8	=	30.3	(81)
Northwest 0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	10.14	(81)
Northwest 0.9x	0.77	x	0.9	x	22.97	x	0.4	x	0.8	=	4.58	(81)
Northwest 0.9x	0.77	x	5.95	x	41.38	x	0.4	x	0.8	=	54.6	(81)
Northwest 0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	18.26	(81)
Northwest 0.9x	0.77	x	0.9	x	41.38	x	0.4	x	0.8	=	8.26	(81)
Northwest 0.9x	0.77	x	5.95	x	67.96	x	0.4	x	0.8	=	89.67	(81)
Northwest 0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	29.99	(81)
Northwest 0.9x	0.77	x	0.9	x	67.96	x	0.4	x	0.8	=	13.56	(81)
Northwest 0.9x	0.77	x	5.95	x	91.35	x	0.4	x	0.8	=	120.53	(81)
Northwest 0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	40.31	(81)
Northwest 0.9x	0.77	x	0.9	x	91.35	x	0.4	x	0.8	=	18.23	(81)
Northwest 0.9x	0.77	x	5.95	x	97.38	x	0.4	x	0.8	=	128.5	(81)
Northwest 0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	42.98	(81)
Northwest 0.9x	0.77	x	0.9	x	97.38	x	0.4	x	0.8	=	19.44	(81)
Northwest 0.9x	0.77	x	5.95	x	91.1	x	0.4	x	0.8	=	120.21	(81)
Northwest 0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	40.2	(81)

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Northwest 0.9x	0.77	x	0.9	x	91.1	x	0.4	x	0.8	=	18.18	(81)
Northwest 0.9x	0.77	x	5.95	x	72.63	x	0.4	x	0.8	=	95.83	(81)
Northwest 0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	32.05	(81)
Northwest 0.9x	0.77	x	0.9	x	72.63	x	0.4	x	0.8	=	14.5	(81)
Northwest 0.9x	0.77	x	5.95	x	50.42	x	0.4	x	0.8	=	66.53	(81)
Northwest 0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	22.25	(81)
Northwest 0.9x	0.77	x	0.9	x	50.42	x	0.4	x	0.8	=	10.06	(81)
Northwest 0.9x	0.77	x	5.95	x	28.07	x	0.4	x	0.8	=	37.03	(81)
Northwest 0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	12.39	(81)
Northwest 0.9x	0.77	x	0.9	x	28.07	x	0.4	x	0.8	=	5.6	(81)
Northwest 0.9x	0.77	x	5.95	x	14.2	x	0.4	x	0.8	=	18.73	(81)
Northwest 0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	6.27	(81)
Northwest 0.9x	0.77	x	0.9	x	14.2	x	0.4	x	0.8	=	2.83	(81)
Northwest 0.9x	0.77	x	5.95	x	9.21	x	0.4	x	0.8	=	12.16	(81)
Northwest 0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	4.07	(81)
Northwest 0.9x	0.77	x	0.9	x	9.21	x	0.4	x	0.8	=	1.84	(81)

Solar gains in watts, calculated for each month

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

(83)m=	72.3	130.5	198.07	278.13	341.38	352.04	333.94	284.74	225.48	149.49	87.94	61.01	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	689.13	743.02	788.96	835.37	864.1	843.79	807.51	766.55	726.58	684.45	660.6	662.26	(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=	0.99	0.98	0.96	0.89	0.75	0.55	0.4	0.44	0.68	0.91	0.98	0.99	(86)

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

(87)m=	20.28	20.4	20.58	20.8	20.94	20.99	21	21	20.98	20.81	20.52	20.26	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.95	0.87	0.7	0.48	0.33	0.36	0.61	0.88	0.97	0.99	(89)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(90)m=	19.2	19.37	19.63	19.94	20.11	20.17	20.17	20.18	20.15	19.96	19.55	19.18	(90)
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fLA = Living area ÷ (4) =

0.39 (91)

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

(92)m=	19.62	19.77	20	20.28	20.44	20.49	20.5	20.5	20.47	20.29	19.93	19.6	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.62	19.77	20	20.28	20.44	20.49	20.5	20.5	20.47	20.29	19.93	19.6	(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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

## SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.98	0.97	0.94	0.87	0.72	0.51	0.36	0.39	0.63	0.88	0.97	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	677.34	722.2	745.52	726.34	621.47	430.98	287.01	300.54	461.02	604.99	638.61	652.88	(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=	1181.71	1142.92	1034.16	856.82	655.61	434.47	287.32	301.1	473.41	727.34	969.56	1171.88	(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=	375.25	282.72	214.75	93.94	25.41	0	0	0	0	91.03	238.28	386.13	
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Total per year (kWh/year) = Sum(98)<sub>...5,9...12</sub> = 1707.51 (98)

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

20.65 (99)

### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

#### Space heating

Annual space heating requirement 1707.51

Space heat from Community heat pump (98) x (304a) x (305) x (306) = 1792.89 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

#### Water heating

Annual water heating requirement 2127.66

If DHW from community scheme:

Water heat from Community heat pump (64) x (303a) x (305) x (306) = 2234.04 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 40.27 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside 229.32 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 229.32 (331)

## SAP WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)	355.57	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =	4611.82	(338)

### 10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year
Space heating from CHP	(307a) x		4.24	x 0.01 =	76.02 (340a)
Water heating from CHP	(310a) x		4.24	x 0.01 =	94.72 (342a)
			Fuel Price		
Pumps and fans	(331)		13.19	x 0.01 =	30.25 (349)
Energy for lighting	(332)		13.19	x 0.01 =	46.9 (350)
Additional standing charges (Table 12)					120 (351)
<b>Total energy cost</b>	= (340a)...(342e) + (345)...(354) =				367.89 (355)

### 11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42 (356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.21 (357)
<b>SAP rating (section12)</b>		83.12 (358)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	<small>If there is CHP using two fuels repeat (363) to (366) for the second fuel</small>				383 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	545.69 (367)
Electrical energy for heat distribution	[(313) x		0.52	=	20.9 (372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)			=	566.59 (373)
CO2 associated with space heating (secondary)	(309) x		0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				566.59 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	119.02 (378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	184.54 (379)
<b>Total CO2, kg/year</b>	sum of (376)...(382) =				870.14 (383)
<b>Dwelling CO2 Emission Rate</b>	(383) ÷ (4) =				10.52 (384)
<b>EI rating (section 14)</b>					90.87 (385)

### 13b. Primary Energy – Community heating scheme

	Energy kWh/year		Primary factor		P.Energy kWh/year
Energy from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	<small>If there is CHP using two fuels repeat (363) to (366) for the second fuel</small>				383 (367a)



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Energy associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	3.07	=	3227.85	(367)
Electrical energy for heat distribution	$[(313) \times$		=	123.63	(372)
Total Energy associated with community systems	$(363)...(366) + (368)...(372)$		=	3351.48	(373)
<i>if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)</i>				3351.48	(373)
Energy associated with space heating (secondary)	$(309) \times$	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	$(312) \times$	1.22	=	0	(375)
Total Energy associated with space and water heating	$(373) + (374) + (375) =$			3351.48	(376)
Energy associated with space cooling	$(315) \times$	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	$(331)) \times$	3.07	=	704.02	(378)
Energy associated with electricity for lighting	$(332)) \times$	3.07	=	1091.6	(379)
<b>Total Primary Energy, kWh/year</b>	sum of (376)...(382) =			5147.1	(383)



## DER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	Ben Talbutt	<b>Stroma Number:</b>	STRO036639
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.17

Property Address: D1-01

### Address :

#### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	42.39	(1a) x	2.82	(2a) =	119.54 (3a)
First floor	40.31	(1b) x	3.15	(2b) =	126.98 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	82.7	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	246.52 (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							0	x 10 =	0 (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) =	0	÷ (5) =	0 (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			3 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.15 (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			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.13 (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
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# 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
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

74.8 (23c)

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

(24a)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)
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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	(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)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

(25)m=	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.52	x 1.48	= 3.7296		(26)
Windows Type 1			0.72	x 1/[1/(1.4)+0.04]	= 0.95		(27)
Windows Type 2			1.61	x 1/[1/(1.4)+0.04]	= 2.13		(27)
Windows Type 3			2.01	x 1/[1/(1.4)+0.04]	= 2.66		(27)
Windows Type 4			0.91	x 1/[1/(1.4)+0.04]	= 1.21		(27)
Windows Type 5			5.95	x 1/[1/(1.4)+0.04]	= 7.89		(27)
Windows Type 6			1.99	x 1/[1/(1.4)+0.04]	= 2.64		(27)
Windows Type 7			0.9	x 1/[1/(1.4)+0.04]	= 1.19		(27)
Windows Type 8			0.9	x 1/[1/(1.4)+0.04]	= 1.19		(27)
Floor			42.39	x 0.1	= 4.239		(28)
Walls Type1	95.6	17.51	78.09	x 0.14	= 10.93		(29)
Walls Type2	12.99	0	12.99	x 0.2	= 2.6		(29)
Total area of elements, m²			150.98				(31)
Party wall			56.48	x 0	= 0		(32)

\* 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) = 41.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K 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

# DER WorkSheet: New dwelling design stage

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	
(38)m=	23.47	23.22	22.96	21.66	21.4	20.1	20.1	19.84	20.62	21.4	21.92	22.44	(38)

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

(39)m=	77.13	76.87	76.61	75.31	75.05	73.75	73.75	73.5	74.27	75.05	75.57	76.09	
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Average = Sum(39)<sub>1...12</sub> /12=  (39)

Heat loss parameter (HLP), W/m<sup>2</sup>K (40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.91	0.91	0.89	0.89	0.89	0.9	0.91	0.91	0.92	
--------	------	------	------	------	------	------	------	------	-----	------	------	------	--

Average = Sum(40)<sub>1...12</sub> /12=  (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  (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)<sup>2</sup>)] + 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  (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	
(44)m=	103.25	99.49	95.74	91.99	88.23	84.48	84.48	88.23	91.99	95.74	99.49	103.25	

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

Total = Sum(44)<sub>1...12</sub> =  (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=	153.11	133.92	138.19	120.48	115.6	99.75	92.44	106.07	107.34	125.09	136.55	148.28	
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Total = Sum(45)<sub>1...12</sub> =  (45)

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

(46)m=	22.97	20.09	20.73	18.07	17.34	14.96	13.87	15.91	16.1	18.76	20.48	22.24	
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel  (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):  (48)

Temperature factor from Table 2b  (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a  (52)

Temperature factor from Table 2b  (53)

## DER WorkSheet: New dwelling design stage

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

1.03
1.03

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

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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(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= 

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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(57)

Primary circuit loss (annual) from Table 3 

0
---

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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 x (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 x (45)m + (46)m + (57)m + (59)m + (61)m  
 (62)m= 

208.39	183.84	193.47	173.97	170.88	153.25	147.71	161.35	160.83	180.37	190.04	203.56
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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 FGHRHS and/or WWHRHS 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= 

208.39	183.84	193.47	173.97	170.88	153.25	147.71	161.35	160.83	180.37	190.04	203.56
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Output from water heater (annual)<sub>1...12</sub>

2127.66
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(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= 

95.13	84.47	90.17	82.85	82.66	75.96	74.96	79.49	78.49	85.81	88.2	93.53
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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
125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6

(66)

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

20.13	17.88	14.54	11.01	8.23	6.95	7.51	9.76	13.1	16.63	19.41	20.69
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(67)

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

224.99	227.33	221.44	208.92	193.11	178.25	168.32	165.98	171.87	184.39	200.2	215.06
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

(68)

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

35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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= 

-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48
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(71)

Water heating gains (Table 5)  
 (72)m= 

127.87	125.7	121.19	115.07	111.1	105.5	100.75	106.84	109.01	115.34	122.5	125.71
--------	-------	--------	--------	-------	-------	--------	--------	--------	--------	-------	--------

(72)

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

433.67	431.59	417.86	395.68	373.12	351.38	337.26	343.27	354.66	377.05	402.79	422.14
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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.

## DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)
Southeast 0.9x	0.77	x	0.72	x	36.79	x	0.4	x	0.8	=	5.87 (77)
Southeast 0.9x	0.77	x	1.61	x	36.79	x	0.4	x	0.8	=	13.14 (77)
Southeast 0.9x	0.77	x	2.01	x	36.79	x	0.4	x	0.8	=	16.4 (77)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.4	x	0.8	=	7.43 (77)
Southeast 0.9x	0.77	x	0.72	x	62.67	x	0.4	x	0.8	=	10.01 (77)
Southeast 0.9x	0.77	x	1.61	x	62.67	x	0.4	x	0.8	=	22.38 (77)
Southeast 0.9x	0.77	x	2.01	x	62.67	x	0.4	x	0.8	=	27.94 (77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.4	x	0.8	=	12.65 (77)
Southeast 0.9x	0.77	x	0.72	x	85.75	x	0.4	x	0.8	=	13.69 (77)
Southeast 0.9x	0.77	x	1.61	x	85.75	x	0.4	x	0.8	=	30.62 (77)
Southeast 0.9x	0.77	x	2.01	x	85.75	x	0.4	x	0.8	=	38.22 (77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.4	x	0.8	=	17.31 (77)
Southeast 0.9x	0.77	x	0.72	x	106.25	x	0.4	x	0.8	=	16.96 (77)
Southeast 0.9x	0.77	x	1.61	x	106.25	x	0.4	x	0.8	=	37.94 (77)
Southeast 0.9x	0.77	x	2.01	x	106.25	x	0.4	x	0.8	=	47.36 (77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.4	x	0.8	=	21.44 (77)
Southeast 0.9x	0.77	x	0.72	x	119.01	x	0.4	x	0.8	=	19 (77)
Southeast 0.9x	0.77	x	1.61	x	119.01	x	0.4	x	0.8	=	42.49 (77)
Southeast 0.9x	0.77	x	2.01	x	119.01	x	0.4	x	0.8	=	53.05 (77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.4	x	0.8	=	24.02 (77)
Southeast 0.9x	0.77	x	0.72	x	118.15	x	0.4	x	0.8	=	18.86 (77)
Southeast 0.9x	0.77	x	1.61	x	118.15	x	0.4	x	0.8	=	42.18 (77)
Southeast 0.9x	0.77	x	2.01	x	118.15	x	0.4	x	0.8	=	52.66 (77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.4	x	0.8	=	23.84 (77)
Southeast 0.9x	0.77	x	0.72	x	113.91	x	0.4	x	0.8	=	18.19 (77)
Southeast 0.9x	0.77	x	1.61	x	113.91	x	0.4	x	0.8	=	40.67 (77)
Southeast 0.9x	0.77	x	2.01	x	113.91	x	0.4	x	0.8	=	50.77 (77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.4	x	0.8	=	22.99 (77)
Southeast 0.9x	0.77	x	0.72	x	104.39	x	0.4	x	0.8	=	16.67 (77)
Southeast 0.9x	0.77	x	1.61	x	104.39	x	0.4	x	0.8	=	37.27 (77)
Southeast 0.9x	0.77	x	2.01	x	104.39	x	0.4	x	0.8	=	46.53 (77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.4	x	0.8	=	21.07 (77)
Southeast 0.9x	0.77	x	0.72	x	92.85	x	0.4	x	0.8	=	14.83 (77)
Southeast 0.9x	0.77	x	1.61	x	92.85	x	0.4	x	0.8	=	33.15 (77)
Southeast 0.9x	0.77	x	2.01	x	92.85	x	0.4	x	0.8	=	41.39 (77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.4	x	0.8	=	18.74 (77)
Southeast 0.9x	0.77	x	0.72	x	69.27	x	0.4	x	0.8	=	11.06 (77)
Southeast 0.9x	0.77	x	1.61	x	69.27	x	0.4	x	0.8	=	24.73 (77)
Southeast 0.9x	0.77	x	2.01	x	69.27	x	0.4	x	0.8	=	30.88 (77)

## DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.4	x	0.8	=	13.98	(77)
Southeast 0.9x	0.77	x	0.72	x	44.07	x	0.4	x	0.8	=	7.04	(77)
Southeast 0.9x	0.77	x	1.61	x	44.07	x	0.4	x	0.8	=	15.73	(77)
Southeast 0.9x	0.77	x	2.01	x	44.07	x	0.4	x	0.8	=	19.64	(77)
Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.4	x	0.8	=	8.89	(77)
Southeast 0.9x	0.77	x	0.72	x	31.49	x	0.4	x	0.8	=	5.03	(77)
Southeast 0.9x	0.77	x	1.61	x	31.49	x	0.4	x	0.8	=	11.24	(77)
Southeast 0.9x	0.77	x	2.01	x	31.49	x	0.4	x	0.8	=	14.04	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.4	x	0.8	=	6.35	(77)
Southwest 0.9x	0.77	x	0.9	x	36.79		0.4	x	0.8	=	7.34	(79)
Southwest 0.9x	0.77	x	0.9	x	62.67		0.4	x	0.8	=	12.51	(79)
Southwest 0.9x	0.77	x	0.9	x	85.75		0.4	x	0.8	=	17.11	(79)
Southwest 0.9x	0.77	x	0.9	x	106.25		0.4	x	0.8	=	21.21	(79)
Southwest 0.9x	0.77	x	0.9	x	119.01		0.4	x	0.8	=	23.75	(79)
Southwest 0.9x	0.77	x	0.9	x	118.15		0.4	x	0.8	=	23.58	(79)
Southwest 0.9x	0.77	x	0.9	x	113.91		0.4	x	0.8	=	22.73	(79)
Southwest 0.9x	0.77	x	0.9	x	104.39		0.4	x	0.8	=	20.83	(79)
Southwest 0.9x	0.77	x	0.9	x	92.85		0.4	x	0.8	=	18.53	(79)
Southwest 0.9x	0.77	x	0.9	x	69.27		0.4	x	0.8	=	13.82	(79)
Southwest 0.9x	0.77	x	0.9	x	44.07		0.4	x	0.8	=	8.8	(79)
Southwest 0.9x	0.77	x	0.9	x	31.49		0.4	x	0.8	=	6.28	(79)
Northwest 0.9x	0.77	x	5.95	x	11.28	x	0.4	x	0.8	=	14.89	(81)
Northwest 0.9x	0.77	x	1.99	x	11.28	x	0.4	x	0.8	=	4.98	(81)
Northwest 0.9x	0.77	x	0.9	x	11.28	x	0.4	x	0.8	=	2.25	(81)
Northwest 0.9x	0.77	x	5.95	x	22.97	x	0.4	x	0.8	=	30.3	(81)
Northwest 0.9x	0.77	x	1.99	x	22.97	x	0.4	x	0.8	=	10.14	(81)
Northwest 0.9x	0.77	x	0.9	x	22.97	x	0.4	x	0.8	=	4.58	(81)
Northwest 0.9x	0.77	x	5.95	x	41.38	x	0.4	x	0.8	=	54.6	(81)
Northwest 0.9x	0.77	x	1.99	x	41.38	x	0.4	x	0.8	=	18.26	(81)
Northwest 0.9x	0.77	x	0.9	x	41.38	x	0.4	x	0.8	=	8.26	(81)
Northwest 0.9x	0.77	x	5.95	x	67.96	x	0.4	x	0.8	=	89.67	(81)
Northwest 0.9x	0.77	x	1.99	x	67.96	x	0.4	x	0.8	=	29.99	(81)
Northwest 0.9x	0.77	x	0.9	x	67.96	x	0.4	x	0.8	=	13.56	(81)
Northwest 0.9x	0.77	x	5.95	x	91.35	x	0.4	x	0.8	=	120.53	(81)
Northwest 0.9x	0.77	x	1.99	x	91.35	x	0.4	x	0.8	=	40.31	(81)
Northwest 0.9x	0.77	x	0.9	x	91.35	x	0.4	x	0.8	=	18.23	(81)
Northwest 0.9x	0.77	x	5.95	x	97.38	x	0.4	x	0.8	=	128.5	(81)
Northwest 0.9x	0.77	x	1.99	x	97.38	x	0.4	x	0.8	=	42.98	(81)
Northwest 0.9x	0.77	x	0.9	x	97.38	x	0.4	x	0.8	=	19.44	(81)
Northwest 0.9x	0.77	x	5.95	x	91.1	x	0.4	x	0.8	=	120.21	(81)
Northwest 0.9x	0.77	x	1.99	x	91.1	x	0.4	x	0.8	=	40.2	(81)

## DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	0.9	x	91.1	x	0.4	x	0.8	=	18.18	(81)
Northwest 0.9x	0.77	x	5.95	x	72.63	x	0.4	x	0.8	=	95.83	(81)
Northwest 0.9x	0.77	x	1.99	x	72.63	x	0.4	x	0.8	=	32.05	(81)
Northwest 0.9x	0.77	x	0.9	x	72.63	x	0.4	x	0.8	=	14.5	(81)
Northwest 0.9x	0.77	x	5.95	x	50.42	x	0.4	x	0.8	=	66.53	(81)
Northwest 0.9x	0.77	x	1.99	x	50.42	x	0.4	x	0.8	=	22.25	(81)
Northwest 0.9x	0.77	x	0.9	x	50.42	x	0.4	x	0.8	=	10.06	(81)
Northwest 0.9x	0.77	x	5.95	x	28.07	x	0.4	x	0.8	=	37.03	(81)
Northwest 0.9x	0.77	x	1.99	x	28.07	x	0.4	x	0.8	=	12.39	(81)
Northwest 0.9x	0.77	x	0.9	x	28.07	x	0.4	x	0.8	=	5.6	(81)
Northwest 0.9x	0.77	x	5.95	x	14.2	x	0.4	x	0.8	=	18.73	(81)
Northwest 0.9x	0.77	x	1.99	x	14.2	x	0.4	x	0.8	=	6.27	(81)
Northwest 0.9x	0.77	x	0.9	x	14.2	x	0.4	x	0.8	=	2.83	(81)
Northwest 0.9x	0.77	x	5.95	x	9.21	x	0.4	x	0.8	=	12.16	(81)
Northwest 0.9x	0.77	x	1.99	x	9.21	x	0.4	x	0.8	=	4.07	(81)
Northwest 0.9x	0.77	x	0.9	x	9.21	x	0.4	x	0.8	=	1.84	(81)

Solar gains in watts, calculated for each month

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

(83)m=	72.3	130.5	198.07	278.13	341.38	352.04	333.94	284.74	225.48	149.49	87.94	61.01	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	505.97	562.09	615.93	673.81	714.5	703.43	671.2	628.01	580.13	526.54	490.73	483.15	(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)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	1	1	0.99	0.95	0.85	0.65	0.48	0.53	0.8	0.97	0.99	1	

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

(87)m=	20.07	20.2	20.4	20.68	20.89	20.98	21	21	20.94	20.68	20.33	20.06	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.15	20.16	20.16	20.17	20.17	20.18	20.17	20.16	20.16	20.15	(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	0.8	0.58	0.39	0.44	0.73	0.95	0.99	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=	18.9	19.08	19.38	19.78	20.06	20.16	20.17	20.18	20.12	19.79	19.29	18.88	(90)
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fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	19.36	19.52	19.78	20.13	20.38	20.48	20.49	20.5	20.44	20.13	19.69	19.34	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.36	19.52	19.78	20.13	20.38	20.48	20.49	20.5	20.44	20.13	19.69	19.34	(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
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## DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.94	0.82	0.6	0.43	0.48	0.76	0.95	0.99	1	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	503.95	557.59	603.58	630.88	583.49	425.28	286.39	299.34	439.41	502.4	486.42	481.66	(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=	1161.2	1123.43	1017.36	845.88	651.54	433.89	287.25	300.97	471.17	715.57	951.79	1151.87	(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=	488.99	380.25	307.85	154.8	50.62	0	0	0	0	158.6	335.07	498.64	
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> = 2374.82 (98)

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

	28.72	(99)
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### 9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

*The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.*

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

#### Space heating

Annual space heating requirement 2374.82 kWh/year

Space heat from Community heat pump (98) x (304a) x (305) x (306) = 2493.56 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

#### Water heating

Annual water heating requirement 2127.66

If DHW from community scheme:  
Water heat from Community heat pump (64) x (303a) x (305) x (306) = 2234.04 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 47.28 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):  
mechanical ventilation - balanced, extract or positive input from outside 229.32 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 229.32 (331)



## DER WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)	355.57	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =	5312.49	(338)

### 12b. CO2 Emissions – Community heating scheme

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%) <span style="color: blue; font-size: small;">If there is CHP using two fuels repeat (363) to (366) for the second fuel</span>					383 (367a)
CO2 associated with heat source 1 <span style="color: blue; font-size: small;">[(307b)+(310b)] x 100 ÷ (367b) x</span>			0.52	=	640.63 (367)
Electrical energy for heat distribution <span style="color: blue; font-size: small;">[(313) x</span>			0.52	=	24.54 (372)
Total CO2 associated with community systems <span style="color: blue; font-size: small;">(363)...(366) + (368)...(372)</span>				=	665.17 (373)
CO2 associated with space heating (secondary) <span style="color: blue; font-size: small;">(309) x</span>			0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater <span style="color: blue; font-size: small;">(312) x</span>			0.22	=	0 (375)
Total CO2 associated with space and water heating <span style="color: blue; font-size: small;">(373) + (374) + (375) =</span>					665.17 (376)
CO2 associated with electricity for pumps and fans within dwelling <span style="color: blue; font-size: small;">(331) x</span>			0.52	=	119.02 (378)
CO2 associated with electricity for lighting <span style="color: blue; font-size: small;">(332)) x</span>			0.52	=	184.54 (379)
<b>Total CO2, kg/year</b> <span style="color: blue; font-size: small;">sum of (376)...(382) =</span>					968.73 (383)
<b>Dwelling CO2 Emission Rate</b> <span style="color: blue; font-size: small;">(383) ÷ (4) =</span>					11.71 (384)
<b>EI rating (section 14)</b>					89.83 (385)

## TER WorkSheet: New dwelling design stage

### User Details:

<b>Assessor Name:</b>	Ben Talbutt	<b>Stroma Number:</b>	STRO036639
<b>Software Name:</b>	Stroma FSAP 2012	<b>Software Version:</b>	Version: 1.0.5.17

Property Address: D1-01

### Address :

### 1. Overall dwelling dimensions:

	Area(m <sup>2</sup> )		Av. Height(m)		Volume(m <sup>3</sup> )
Ground floor	42.39	(1a) x	2.82	(2a) =	119.54 (3a)
First floor	40.31	(1b) x	3.15	(2b) =	126.98 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	82.7	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	246.52 (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							3	x 10 =	30 (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) =	30	÷ (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 Infiltration rate = 0.25 - [0.2 x (14) ÷ 100] =			0 (15)
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			2 (19)
Shelter factor (20) = 1 - [0.075 x (19)] =			0.85 (20)
Infiltration rate incorporating shelter factor (21) = (18) x (20) =			0.32 (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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# 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
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0	(23a)
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If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0	(23b)
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If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0	(23c)
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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)
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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	(24b)
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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	(24c)
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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=	0.58	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(24d)
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.58	0.57	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)
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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
Doors			2.52	x 1	= 2.52		(26)
Windows Type 1			0.72	x 1/[1/( 1.4 )+ 0.04]	= 0.95		(27)
Windows Type 2			1.61	x 1/[1/( 1.4 )+ 0.04]	= 2.13		(27)
Windows Type 3			2.01	x 1/[1/( 1.4 )+ 0.04]	= 2.66		(27)
Windows Type 4			0.91	x 1/[1/( 1.4 )+ 0.04]	= 1.21		(27)
Windows Type 5			5.95	x 1/[1/( 1.4 )+ 0.04]	= 7.89		(27)
Windows Type 6			1.99	x 1/[1/( 1.4 )+ 0.04]	= 2.64		(27)
Windows Type 7			0.9	x 1/[1/( 1.4 )+ 0.04]	= 1.19		(27)
Windows Type 8			0.9	x 1/[1/( 1.4 )+ 0.04]	= 1.19		(27)
Floor			42.39	x 0.13	= 5.5107		(28)
Walls Type1	95.6	17.51	78.09	x 0.18	= 14.06		(29)
Walls Type2	12.99	0	12.99	x 0.18	= 2.34		(29)
Total area of elements, m <sup>2</sup>			150.98				(31)
Party wall			56.48	x 0	= 0		(32)

\* 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) = 44.3 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 0 (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

# TER WorkSheet: New dwelling design stage

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	
(38)m=	47.28	47.02	46.77	45.59	45.37	44.34	44.34	44.15	44.74	45.37	45.81	46.28	(38)

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

(39)m=	100.66	100.4	100.15	98.97	98.75	97.72	97.72	97.53	98.12	98.75	99.2	99.67	(39)
Average = Sum(39) <sub>1...12</sub> / 12 =												<input type="text" value="98.97"/> (39)	

Heat loss parameter (HLP), W/m<sup>2</sup>K (40)m = (39)m ÷ (4)

(40)m=	1.22	1.21	1.21	1.2	1.19	1.18	1.18	1.18	1.19	1.19	1.2	1.21	(40)
Average = Sum(40) <sub>1...12</sub> / 12 =												<input type="text" value="1.2"/> (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  (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)<sup>2</sup>)] + 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  (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	
(44)m=	103.25	99.49	95.74	91.99	88.23	84.48	84.48	88.23	91.99	95.74	99.49	103.25	(44)
Total = Sum(44) <sub>1...12</sub> =												<input type="text" value="1126.35"/> (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=	153.11	133.92	138.19	120.48	115.6	99.75	92.44	106.07	107.34	125.09	136.55	148.28	(45)
Total = Sum(45) <sub>1...12</sub> =												<input type="text" value="1476.82"/> (45)	

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

(46)m= 

22.97	20.09	20.73	18.07	17.34	14.96	13.87	15.91	16.1	18.76	20.48	22.24
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(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel  (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):  (48)

Temperature factor from Table 2b  (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a  (52)

Temperature factor from Table 2b  (53)

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

0
0.75

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

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

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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= 

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3 

0
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(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (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 x (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 x (45)m + (46)m + (57)m + (59)m + (61)m  
 (62)m= 

199.71	176	184.78	165.57	162.19	144.85	139.03	152.67	152.43	171.69	181.64	194.88
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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
---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater  
 (64)m= 

199.71	176	184.78	165.57	162.19	144.85	139.03	152.67	152.43	171.69	181.64	194.88
--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2025.44
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(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= 

88.19	78.2	83.22	76.13	75.71	69.24	68.01	72.54	71.76	78.87	81.48	86.58
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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
	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6	125.6

(66)

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

20.46	18.18	14.78	11.19	8.37	7.06	7.63	9.92	13.31	16.9	19.73	21.03
-------	-------	-------	-------	------	------	------	------	-------	------	-------	-------

(67)

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

224.99	227.33	221.44	208.92	193.11	178.25	168.32	165.98	171.87	184.39	200.2	215.06
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(68)

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

35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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= 

-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48	-100.48
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(71)

Water heating gains (Table 5)  
 (72)m= 

118.53	116.36	111.86	105.74	101.76	96.17	91.41	97.51	99.67	106.01	113.16	116.37
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

(72)

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

427.67	425.54	411.76	389.53	366.92	345.16	331.04	337.09	348.53	370.99	396.78	416.15
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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.

## TER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m <sup>2</sup>		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)
Southeast 0.9x	0.77	x	0.72	x	36.79	x	0.63	x	0.7	=	8.1 (77)
Southeast 0.9x	0.77	x	1.61	x	36.79	x	0.63	x	0.7	=	18.1 (77)
Southeast 0.9x	0.77	x	2.01	x	36.79	x	0.63	x	0.7	=	22.6 (77)
Southeast 0.9x	0.77	x	0.91	x	36.79	x	0.63	x	0.7	=	10.23 (77)
Southeast 0.9x	0.77	x	0.72	x	62.67	x	0.63	x	0.7	=	13.79 (77)
Southeast 0.9x	0.77	x	1.61	x	62.67	x	0.63	x	0.7	=	30.84 (77)
Southeast 0.9x	0.77	x	2.01	x	62.67	x	0.63	x	0.7	=	38.5 (77)
Southeast 0.9x	0.77	x	0.91	x	62.67	x	0.63	x	0.7	=	17.43 (77)
Southeast 0.9x	0.77	x	0.72	x	85.75	x	0.63	x	0.7	=	18.87 (77)
Southeast 0.9x	0.77	x	1.61	x	85.75	x	0.63	x	0.7	=	42.19 (77)
Southeast 0.9x	0.77	x	2.01	x	85.75	x	0.63	x	0.7	=	52.68 (77)
Southeast 0.9x	0.77	x	0.91	x	85.75	x	0.63	x	0.7	=	23.85 (77)
Southeast 0.9x	0.77	x	0.72	x	106.25	x	0.63	x	0.7	=	23.38 (77)
Southeast 0.9x	0.77	x	1.61	x	106.25	x	0.63	x	0.7	=	52.28 (77)
Southeast 0.9x	0.77	x	2.01	x	106.25	x	0.63	x	0.7	=	65.27 (77)
Southeast 0.9x	0.77	x	0.91	x	106.25	x	0.63	x	0.7	=	29.55 (77)
Southeast 0.9x	0.77	x	0.72	x	119.01	x	0.63	x	0.7	=	26.19 (77)
Southeast 0.9x	0.77	x	1.61	x	119.01	x	0.63	x	0.7	=	58.56 (77)
Southeast 0.9x	0.77	x	2.01	x	119.01	x	0.63	x	0.7	=	73.11 (77)
Southeast 0.9x	0.77	x	0.91	x	119.01	x	0.63	x	0.7	=	33.1 (77)
Southeast 0.9x	0.77	x	0.72	x	118.15	x	0.63	x	0.7	=	26 (77)
Southeast 0.9x	0.77	x	1.61	x	118.15	x	0.63	x	0.7	=	58.13 (77)
Southeast 0.9x	0.77	x	2.01	x	118.15	x	0.63	x	0.7	=	72.58 (77)
Southeast 0.9x	0.77	x	0.91	x	118.15	x	0.63	x	0.7	=	32.86 (77)
Southeast 0.9x	0.77	x	0.72	x	113.91	x	0.63	x	0.7	=	25.06 (77)
Southeast 0.9x	0.77	x	1.61	x	113.91	x	0.63	x	0.7	=	56.05 (77)
Southeast 0.9x	0.77	x	2.01	x	113.91	x	0.63	x	0.7	=	69.97 (77)
Southeast 0.9x	0.77	x	0.91	x	113.91	x	0.63	x	0.7	=	31.68 (77)
Southeast 0.9x	0.77	x	0.72	x	104.39	x	0.63	x	0.7	=	22.97 (77)
Southeast 0.9x	0.77	x	1.61	x	104.39	x	0.63	x	0.7	=	51.36 (77)
Southeast 0.9x	0.77	x	2.01	x	104.39	x	0.63	x	0.7	=	64.13 (77)
Southeast 0.9x	0.77	x	0.91	x	104.39	x	0.63	x	0.7	=	29.03 (77)
Southeast 0.9x	0.77	x	0.72	x	92.85	x	0.63	x	0.7	=	20.43 (77)
Southeast 0.9x	0.77	x	1.61	x	92.85	x	0.63	x	0.7	=	45.69 (77)
Southeast 0.9x	0.77	x	2.01	x	92.85	x	0.63	x	0.7	=	57.04 (77)
Southeast 0.9x	0.77	x	0.91	x	92.85	x	0.63	x	0.7	=	25.82 (77)
Southeast 0.9x	0.77	x	0.72	x	69.27	x	0.63	x	0.7	=	15.24 (77)
Southeast 0.9x	0.77	x	1.61	x	69.27	x	0.63	x	0.7	=	34.08 (77)
Southeast 0.9x	0.77	x	2.01	x	69.27	x	0.63	x	0.7	=	42.55 (77)

## TER WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	0.91	x	69.27	x	0.63	x	0.7	=	19.26	(77)
Southeast 0.9x	0.77	x	0.72	x	44.07	x	0.63	x	0.7	=	9.7	(77)
Southeast 0.9x	0.77	x	1.61	x	44.07	x	0.63	x	0.7	=	21.68	(77)
Southeast 0.9x	0.77	x	2.01	x	44.07	x	0.63	x	0.7	=	27.07	(77)
Southeast 0.9x	0.77	x	0.91	x	44.07	x	0.63	x	0.7	=	12.26	(77)
Southeast 0.9x	0.77	x	0.72	x	31.49	x	0.63	x	0.7	=	6.93	(77)
Southeast 0.9x	0.77	x	1.61	x	31.49	x	0.63	x	0.7	=	15.49	(77)
Southeast 0.9x	0.77	x	2.01	x	31.49	x	0.63	x	0.7	=	19.34	(77)
Southeast 0.9x	0.77	x	0.91	x	31.49	x	0.63	x	0.7	=	8.76	(77)
Southwest 0.9x	0.77	x	0.9	x	36.79		0.63	x	0.7	=	10.12	(79)
Southwest 0.9x	0.77	x	0.9	x	62.67		0.63	x	0.7	=	17.24	(79)
Southwest 0.9x	0.77	x	0.9	x	85.75		0.63	x	0.7	=	23.59	(79)
Southwest 0.9x	0.77	x	0.9	x	106.25		0.63	x	0.7	=	29.22	(79)
Southwest 0.9x	0.77	x	0.9	x	119.01		0.63	x	0.7	=	32.73	(79)
Southwest 0.9x	0.77	x	0.9	x	118.15		0.63	x	0.7	=	32.5	(79)
Southwest 0.9x	0.77	x	0.9	x	113.91		0.63	x	0.7	=	31.33	(79)
Southwest 0.9x	0.77	x	0.9	x	104.39		0.63	x	0.7	=	28.71	(79)
Southwest 0.9x	0.77	x	0.9	x	92.85		0.63	x	0.7	=	25.54	(79)
Southwest 0.9x	0.77	x	0.9	x	69.27		0.63	x	0.7	=	19.05	(79)
Southwest 0.9x	0.77	x	0.9	x	44.07		0.63	x	0.7	=	12.12	(79)
Southwest 0.9x	0.77	x	0.9	x	31.49		0.63	x	0.7	=	8.66	(79)
Northwest 0.9x	0.77	x	5.95	x	11.28	x	0.63	x	0.7	=	20.52	(81)
Northwest 0.9x	0.77	x	1.99	x	11.28	x	0.63	x	0.7	=	6.86	(81)
Northwest 0.9x	0.77	x	0.9	x	11.28	x	0.63	x	0.7	=	3.1	(81)
Northwest 0.9x	0.77	x	5.95	x	22.97	x	0.63	x	0.7	=	41.76	(81)
Northwest 0.9x	0.77	x	1.99	x	22.97	x	0.63	x	0.7	=	13.97	(81)
Northwest 0.9x	0.77	x	0.9	x	22.97	x	0.63	x	0.7	=	6.32	(81)
Northwest 0.9x	0.77	x	5.95	x	41.38	x	0.63	x	0.7	=	75.24	(81)
Northwest 0.9x	0.77	x	1.99	x	41.38	x	0.63	x	0.7	=	25.17	(81)
Northwest 0.9x	0.77	x	0.9	x	41.38	x	0.63	x	0.7	=	11.38	(81)
Northwest 0.9x	0.77	x	5.95	x	67.96	x	0.63	x	0.7	=	123.57	(81)
Northwest 0.9x	0.77	x	1.99	x	67.96	x	0.63	x	0.7	=	41.33	(81)
Northwest 0.9x	0.77	x	0.9	x	67.96	x	0.63	x	0.7	=	18.69	(81)
Northwest 0.9x	0.77	x	5.95	x	91.35	x	0.63	x	0.7	=	166.1	(81)
Northwest 0.9x	0.77	x	1.99	x	91.35	x	0.63	x	0.7	=	55.55	(81)
Northwest 0.9x	0.77	x	0.9	x	91.35	x	0.63	x	0.7	=	25.12	(81)
Northwest 0.9x	0.77	x	5.95	x	97.38	x	0.63	x	0.7	=	177.08	(81)
Northwest 0.9x	0.77	x	1.99	x	97.38	x	0.63	x	0.7	=	59.23	(81)
Northwest 0.9x	0.77	x	0.9	x	97.38	x	0.63	x	0.7	=	26.79	(81)
Northwest 0.9x	0.77	x	5.95	x	91.1	x	0.63	x	0.7	=	165.66	(81)
Northwest 0.9x	0.77	x	1.99	x	91.1	x	0.63	x	0.7	=	55.4	(81)



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Northwest 0.9x	0.77	x	0.9	x	91.1	x	0.63	x	0.7	=	25.06	(81)
Northwest 0.9x	0.77	x	5.95	x	72.63	x	0.63	x	0.7	=	132.06	(81)
Northwest 0.9x	0.77	x	1.99	x	72.63	x	0.63	x	0.7	=	44.17	(81)
Northwest 0.9x	0.77	x	0.9	x	72.63	x	0.63	x	0.7	=	19.98	(81)
Northwest 0.9x	0.77	x	5.95	x	50.42	x	0.63	x	0.7	=	91.68	(81)
Northwest 0.9x	0.77	x	1.99	x	50.42	x	0.63	x	0.7	=	30.66	(81)
Northwest 0.9x	0.77	x	0.9	x	50.42	x	0.63	x	0.7	=	13.87	(81)
Northwest 0.9x	0.77	x	5.95	x	28.07	x	0.63	x	0.7	=	51.04	(81)
Northwest 0.9x	0.77	x	1.99	x	28.07	x	0.63	x	0.7	=	17.07	(81)
Northwest 0.9x	0.77	x	0.9	x	28.07	x	0.63	x	0.7	=	7.72	(81)
Northwest 0.9x	0.77	x	5.95	x	14.2	x	0.63	x	0.7	=	25.82	(81)
Northwest 0.9x	0.77	x	1.99	x	14.2	x	0.63	x	0.7	=	8.63	(81)
Northwest 0.9x	0.77	x	0.9	x	14.2	x	0.63	x	0.7	=	3.9	(81)
Northwest 0.9x	0.77	x	5.95	x	9.21	x	0.63	x	0.7	=	16.76	(81)
Northwest 0.9x	0.77	x	1.99	x	9.21	x	0.63	x	0.7	=	5.6	(81)
Northwest 0.9x	0.77	x	0.9	x	9.21	x	0.63	x	0.7	=	2.53	(81)

Solar gains in watts, calculated for each month

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

(83)m=	99.64	179.84	272.96	383.29	470.46	485.16	460.22	392.41	310.73	206.02	121.19	84.08	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	527.3	605.39	684.73	772.82	837.38	830.32	791.26	729.51	659.27	577	517.96	500.22	(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)
	1	0.99	0.99	0.95	0.87	0.7	0.53	0.59	0.84	0.97	0.99	1	

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

(87)m=	19.7	19.86	20.13	20.48	20.78	20.95	20.99	20.98	20.86	20.48	20.03	19.68	(87)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.91	19.91	19.91	19.92	19.92	19.93	19.93	19.94	19.93	19.92	19.92	19.92	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.47	0.77	0.96	0.99	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=	18.19	18.42	18.81	19.32	19.71	19.9	19.93	19.93	19.82	19.32	18.67	18.16	(90)
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fLA = Living area ÷ (4) = 0.39 (91)

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

(92)m=	18.78	18.98	19.32	19.77	20.13	20.31	20.34	20.34	20.23	19.77	19.2	18.75	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.78	18.98	19.32	19.77	20.13	20.31	20.34	20.34	20.23	19.77	19.2	18.75	(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
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Utilisation factor for gains, hm:

(94)m=	1	0.99	0.98	0.93	0.83	0.64	0.46	0.52	0.79	0.96	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	524.75	599.51	668.92	722.07	692.84	529.2	361.3	376.27	520.87	551.99	512.97	498.33	(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=	1457.45	1413.79	1284.04	1075.99	832.45	557.79	365.77	384.17	601.13	905.48	1200.29	1450.19	(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=	693.93	547.2	457.65	254.82	103.87	0	0	0	0	263	494.87	708.18	
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Total per year (kWh/year) = Sum(98)<sub>1...5,9...12</sub> =

3523.53	(98)
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Space heating requirement in kWh/m<sup>2</sup>/year

42.61	(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) x [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)

693.93	547.2	457.65	254.82	103.87	0	0	0	0	263	494.87	708.18
--------	-------	--------	--------	--------	---	---	---	---	-----	--------	--------

(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

742.17	585.24	489.47	272.54	111.09	0	0	0	0	281.28	529.28	757.42
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Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> =

3768.48	(211)
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Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

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

0	(215)
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### Water heating

Output from water heater (calculated above)

199.71	176	184.78	165.57	162.19	144.85	139.03	152.67	152.43	171.69	181.64	194.88
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Efficiency of water heater 79.8 (216)

(217)m= (217)

87.87	87.64	87.14	85.96	83.66	79.8	79.8	79.8	79.8	85.95	87.36	87.96
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	227.29	200.82	212.05	192.61	193.87	181.51	174.22	191.31	191.02	199.76	207.93	221.57	
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Total = Sum(219a)<sub>1...12</sub> =

2393.96	(219)
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### Annual totals

Space heating fuel used, main system 1 kWh/year kWh/year 3768.48

Water heating fuel used 2393.96

Electricity for pumps, fans and electric keep-hot

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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		361.4	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6598.85	(338)

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

	<b>Energy</b> kWh/year		<b>Emission factor</b> kg CO2/kWh		<b>Emissions</b> kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	813.99 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	517.1 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1331.09 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	187.57 (268)
Total CO2, kg/year		sum of (265)...(271) =			1557.58 (272)
 <b>TER =</b>					 27.69 (273)