

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
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Project Information:

Assessed By: Neil Ingham (STRO010943)

Building Type: End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 118.27m²

Site Reference : Endymion Road

Plot Reference: Endymion Road

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

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 27.47 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 10.96 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 64.3 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 56.8 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric
Mitsubishi ECODAN 5kW

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.42 kWh/day Permitted by DBSCG: 2.03 kWh/day	OK
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Regulations Compliance Report

Primary pipework insulated: Yes OK

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 (Thames valley):	Slight	OK
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Based on:

Overshading:	Average or unknown
Windows facing: West	7.42m ²
Windows facing: West	3.5m ²
Windows facing: North	3.5m ²
Windows facing: South	0.85m ²
Roof windows facing: Horizontal	1m ²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.1 W/m ² K
Party Walls U-value	0 W/m ² K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Neil Ingham
Software Name: Stroma FSAP 2012

Stroma Number: STRO010943
Software Version: Version: 1.0.5.51

Property Address: Endymion Road

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Basement	39.97	(1a) x	2.5	(2a) =	99.93 (3a)
Ground floor	38.33	(1b) x	2.8	(2b) =	107.32 (3b)
First floor	39.97	(1c) x	3	(2c) =	119.91 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	118.27	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	327.16 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	+	0
Number of open flues	0	+	0	+	0
Number of intermittent fans				3	30 (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) =	30	÷ (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			4 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.29 (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) =		0.29 (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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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

	0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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) × [1 – (23c) ÷ 100]

(24a)m= 0 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 0 (24b)

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

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

(24c)m= 0 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= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (24d)

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

(25)m= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (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			1.8	x 1.4	= 2.52		(26)
Windows Type 1			7.42	x1/[1/(1.4)+ 0.04]	= 9.84		(27)
Windows Type 2			3.5	x1/[1/(1.4)+ 0.04]	= 4.64		(27)
Windows Type 3			3.5	x1/[1/(1.4)+ 0.04]	= 4.64		(27)
Windows Type 4			0.85	x1/[1/(1.4)+ 0.04]	= 1.13		(27)
Rooflights			1	x1/[1/(1.4) + 0.04]	= 1.4		(27b)
Floor Type 1			39.97	x 0.15	= 5.995501	110	4396.7 (28)
Floor Type 2			1.64	x 0.15	= 0.246	75	123 (28)
Walls Type1	155.02	10.07	144.95	x 0.18	= 26.09	60	8697 (29)
Walls Type2	63.69	7	56.69	x 0.18	= 10.2	60	3401.4 (29)
Roof Type1	1.64	0	1.64	x 0.1	= 0.16	9	14.76 (30)
Roof Type2	39.97	1	38.97	x 0.12	= 4.68	9	350.73 (30)
Total area of elements, m²			301.93				(31)
Party wall			21.78	x 0	= 0	45	980.1 (32)
Internal wall **			225.18			9	2026.62 (32c)
Internal floor			76.67			18	1380.06 (32d)
Internal ceiling			76.67			9	690.03 (32e)

DER WorkSheet: New dwelling design stage

* 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 = $S(A \times U)$ (26)...(30) + (32) =

71.47

 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) =

22060.4

 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) in kJ/m²K = (34) $\div$ (4) =

186.53

 (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 : $S(L \times Y)$ calculated using Appendix K

18.93

 (36)

if details of thermal bridging are not known (36) = $0.05 \times (31)$

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

90.4

 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	61.45	61.16	60.87	59.54	59.29	58.13	58.13	57.91	58.57	59.29	59.79	60.32	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	151.85	151.56	151.27	149.94	149.69	148.53	148.53	148.31	148.97	149.69	150.19	150.72	
Average = Sum(39) _{1...12} /12=												149.94	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m $\div$ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.28	1.28	1.28	1.27	1.27	1.26	1.26	1.25	1.26	1.27	1.27	1.27	
Average = Sum(40) _{1...12} /12=												1.27	(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

2.86

 (42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

102.04

 (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=	112.24	108.16	104.08	100	95.92	91.84	91.84	95.92	100	104.08	108.16	112.24	
Total = Sum(44) _{1...12} =												1224.47	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	166.45	145.58	150.23	130.97	125.67	108.44	100.49	115.31	116.69	135.99	148.44	161.2	
Total = Sum(45) _{1...12} =												1605.47	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.97	21.84	22.53	19.65	18.85	16.27	15.07	17.3	17.5	20.4	22.27	24.18	(46)

Water storage loss:

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

170

 (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):

1.42

 (48)

Temperature factor from Table 2b

0.54

 (49)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0.77	(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)		0.77	(55)												
Water storage loss calculated for each month	((56)m = (55) x (41)m														
(56)m=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>23.77</td><td>21.47</td><td>23.77</td><td>23</td><td>23.77</td><td>23</td><td>23.77</td><td>23.77</td><td>23</td><td>23.77</td><td>23</td><td>23.77</td> </tr> </table>	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77		(56)
23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77				
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=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>23.77</td><td>21.47</td><td>23.77</td><td>23</td><td>23.77</td><td>23</td><td>23.77</td><td>23.77</td><td>23</td><td>23.77</td><td>23</td><td>23.77</td> </tr> </table>	23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77		(57)
23.77	21.47	23.77	23	23.77	23	23.77	23.77	23	23.77	23	23.77				
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=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>23.26</td><td>21.01</td><td>23.26</td><td>22.51</td><td>23.26</td><td>22.51</td><td>23.26</td><td>23.26</td><td>22.51</td><td>23.26</td><td>22.51</td><td>23.26</td> </tr> </table>	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)
23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26				
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m															
(61)m=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0		(61)
0	0	0	0	0	0	0	0	0	0	0	0				
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=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>213.49</td><td>188.06</td><td>197.26</td><td>176.49</td><td>172.7</td><td>153.96</td><td>147.52</td><td>162.35</td><td>162.21</td><td>183.02</td><td>193.96</td><td>208.23</td> </tr> </table>	213.49	188.06	197.26	176.49	172.7	153.96	147.52	162.35	162.21	183.02	193.96	208.23		(62)
213.49	188.06	197.26	176.49	172.7	153.96	147.52	162.35	162.21	183.02	193.96	208.23				
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=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table>	0	0	0	0	0	0	0	0	0	0	0	0		(63)
0	0	0	0	0	0	0	0	0	0	0	0				
Output from water heater															
(64)m=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>213.49</td><td>188.06</td><td>197.26</td><td>176.49</td><td>172.7</td><td>153.96</td><td>147.52</td><td>162.35</td><td>162.21</td><td>183.02</td><td>193.96</td><td>208.23</td> </tr> </table>	213.49	188.06	197.26	176.49	172.7	153.96	147.52	162.35	162.21	183.02	193.96	208.23		
213.49	188.06	197.26	176.49	172.7	153.96	147.52	162.35	162.21	183.02	193.96	208.23				
											Output from water heater (annual) ^{1...12}	2159.25	(64)		
Heat gains from water heating, kWh/month 0.25 ´ [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]															
(65)m=	<table border="1" style="display: inline-table; border-collapse: collapse; text-align: center;"> <tr> <td>92.97</td><td>82.39</td><td>87.58</td><td>79.96</td><td>79.41</td><td>72.47</td><td>71.04</td><td>75.97</td><td>75.21</td><td>82.84</td><td>85.77</td><td>91.23</td> </tr> </table>	92.97	82.39	87.58	79.96	79.41	72.47	71.04	75.97	75.21	82.84	85.77	91.23		(65)
92.97	82.39	87.58	79.96	79.41	72.47	71.04	75.97	75.21	82.84	85.77	91.23				
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													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	142.82	142.82	142.82	142.82	142.82	142.82	142.82	142.82	142.82	142.82	142.82	142.82	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	27.9	24.78	20.15	15.26	11.41	9.63	10.4	13.52	18.15	23.05	26.9	28.68	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	282.94	285.88	278.48	262.73	242.85	224.16	211.68	208.74	216.14	231.89	251.77	270.46	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	(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=	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	-114.25	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=

124.96	122.61	117.71	111.06	106.74	100.65	95.48	102.11	104.46	111.35	119.13	122.62
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 (72)

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

(73)m=

501.65	499.11	482.19	454.89	426.83	400.29	383.41	390.22	404.6	432.13	463.64	487.6
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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 ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)							
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>10.63</td></tr></table>	10.63	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>11.37</td></tr></table> (74)	11.37
0.77																		
3.5																		
10.63																		
0.63																		
0.7																		
11.37																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>20.32</td></tr></table>	20.32	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.74</td></tr></table> (74)	21.74
0.77																		
3.5																		
20.32																		
0.63																		
0.7																		
21.74																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>34.53</td></tr></table>	34.53	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>36.94</td></tr></table> (74)	36.94
0.77																		
3.5																		
34.53																		
0.63																		
0.7																		
36.94																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>55.46</td></tr></table>	55.46	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>59.33</td></tr></table> (74)	59.33
0.77																		
3.5																		
55.46																		
0.63																		
0.7																		
59.33																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>74.72</td></tr></table>	74.72	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>79.92</td></tr></table> (74)	79.92
0.77																		
3.5																		
74.72																		
0.63																		
0.7																		
79.92																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>79.99</td></tr></table>	79.99	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>85.56</td></tr></table> (74)	85.56
0.77																		
3.5																		
79.99																		
0.63																		
0.7																		
85.56																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>74.68</td></tr></table>	74.68	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>79.88</td></tr></table> (74)	79.88
0.77																		
3.5																		
74.68																		
0.63																		
0.7																		
79.88																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>59.25</td></tr></table>	59.25	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>63.37</td></tr></table> (74)	63.37
0.77																		
3.5																		
59.25																		
0.63																		
0.7																		
63.37																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>41.52</td></tr></table>	41.52	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>44.41</td></tr></table> (74)	44.41
0.77																		
3.5																		
41.52																		
0.63																		
0.7																		
44.41																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>24.19</td></tr></table>	24.19	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>25.87</td></tr></table> (74)	25.87
0.77																		
3.5																		
24.19																		
0.63																		
0.7																		
25.87																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>13.12</td></tr></table>	13.12	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.03</td></tr></table> (74)	14.03
0.77																		
3.5																		
13.12																		
0.63																		
0.7																		
14.03																		
North	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>8.86</td></tr></table>	8.86	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>9.48</td></tr></table> (74)	9.48
0.77																		
3.5																		
8.86																		
0.63																		
0.7																		
9.48																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>46.75</td></tr></table>	46.75	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>12.14</td></tr></table> (78)	12.14
0.77																		
0.85																		
46.75																		
0.63																		
0.7																		
12.14																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>76.57</td></tr></table>	76.57	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>19.89</td></tr></table> (78)	19.89
0.77																		
0.85																		
76.57																		
0.63																		
0.7																		
19.89																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>97.53</td></tr></table>	97.53	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>25.34</td></tr></table> (78)	25.34
0.77																		
0.85																		
97.53																		
0.63																		
0.7																		
25.34																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>110.23</td></tr></table>	110.23	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.64</td></tr></table> (78)	28.64
0.77																		
0.85																		
110.23																		
0.63																		
0.7																		
28.64																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>114.87</td></tr></table>	114.87	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>29.84</td></tr></table> (78)	29.84
0.77																		
0.85																		
114.87																		
0.63																		
0.7																		
29.84																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>110.55</td></tr></table>	110.55	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.72</td></tr></table> (78)	28.72
0.77																		
0.85																		
110.55																		
0.63																		
0.7																		
28.72																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>108.01</td></tr></table>	108.01	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>28.06</td></tr></table> (78)	28.06
0.77																		
0.85																		
108.01																		
0.63																		
0.7																		
28.06																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>104.89</td></tr></table>	104.89	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>27.25</td></tr></table> (78)	27.25
0.77																		
0.85																		
104.89																		
0.63																		
0.7																		
27.25																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>101.89</td></tr></table>	101.89	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>26.47</td></tr></table> (78)	26.47
0.77																		
0.85																		
101.89																		
0.63																		
0.7																		
26.47																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>82.59</td></tr></table>	82.59	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.45</td></tr></table> (78)	21.45
0.77																		
0.85																		
82.59																		
0.63																		
0.7																		
21.45																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>55.42</td></tr></table>	55.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>14.4</td></tr></table> (78)	14.4
0.77																		
0.85																		
55.42																		
0.63																		
0.7																		
14.4																		
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.85</td></tr></table>	0.85	x	<table><tr><td>40.4</td></tr></table>	40.4	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>10.49</td></tr></table> (78)	10.49
0.77																		
0.85																		
40.4																		
0.63																		
0.7																		
10.49																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.42</td></tr></table>	7.42	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>44.54</td></tr></table> (80)	44.54
0.77																		
7.42																		
19.64																		
0.63																		
0.7																		
44.54																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>19.64</td></tr></table>	19.64	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>21.01</td></tr></table> (80)	21.01
0.77																		
3.5																		
19.64																		
0.63																		
0.7																		
21.01																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.42</td></tr></table>	7.42	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>87.12</td></tr></table> (80)	87.12
0.77																		
7.42																		
38.42																		
0.63																		
0.7																		
87.12																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>38.42</td></tr></table>	38.42	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>41.1</td></tr></table> (80)	41.1
0.77																		
3.5																		
38.42																		
0.63																		
0.7																		
41.1																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.42</td></tr></table>	7.42	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>143.48</td></tr></table> (80)	143.48
0.77																		
7.42																		
63.27																		
0.63																		
0.7																		
143.48																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>63.27</td></tr></table>	63.27	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>67.68</td></tr></table> (80)	67.68
0.77																		
3.5																		
63.27																		
0.63																		
0.7																		
67.68																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>7.42</td></tr></table>	7.42	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>209.26</td></tr></table> (80)	209.26
0.77																		
7.42																		
92.28																		
0.63																		
0.7																		
209.26																		
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>3.5</td></tr></table>	3.5	x	<table><tr><td>92.28</td></tr></table>	92.28	x	<table><tr><td>0.63</td></tr></table>	0.63	x	<table><tr><td>0.7</td></tr></table>	0.7	=	<table><tr><td>98.71</td></tr></table> (80)	98.71
0.77																		
3.5																		
92.28																		
0.63																		
0.7																		
98.71																		

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	7.42	x	113.09	x	0.63	x	0.7	=	256.45	(80)
West	0.9x	0.77	x	3.5	x	113.09	x	0.63	x	0.7	=	120.97	(80)
West	0.9x	0.77	x	7.42	x	115.77	x	0.63	x	0.7	=	262.53	(80)
West	0.9x	0.77	x	3.5	x	115.77	x	0.63	x	0.7	=	123.83	(80)
West	0.9x	0.77	x	7.42	x	110.22	x	0.63	x	0.7	=	249.94	(80)
West	0.9x	0.77	x	3.5	x	110.22	x	0.63	x	0.7	=	117.89	(80)
West	0.9x	0.77	x	7.42	x	94.68	x	0.63	x	0.7	=	214.69	(80)
West	0.9x	0.77	x	3.5	x	94.68	x	0.63	x	0.7	=	101.27	(80)
West	0.9x	0.77	x	7.42	x	73.59	x	0.63	x	0.7	=	166.87	(80)
West	0.9x	0.77	x	3.5	x	73.59	x	0.63	x	0.7	=	78.71	(80)
West	0.9x	0.77	x	7.42	x	45.59	x	0.63	x	0.7	=	103.38	(80)
West	0.9x	0.77	x	3.5	x	45.59	x	0.63	x	0.7	=	48.76	(80)
West	0.9x	0.77	x	7.42	x	24.49	x	0.63	x	0.7	=	55.53	(80)
West	0.9x	0.77	x	3.5	x	24.49	x	0.63	x	0.7	=	26.19	(80)
West	0.9x	0.77	x	7.42	x	16.15	x	0.63	x	0.7	=	36.63	(80)
West	0.9x	0.77	x	3.5	x	16.15	x	0.63	x	0.7	=	17.28	(80)
Rooflights	0.9x	1	x	1	x	26	x	0.63	x	0.7	=	10.32	(82)
Rooflights	0.9x	1	x	1	x	54	x	0.63	x	0.7	=	21.43	(82)
Rooflights	0.9x	1	x	1	x	96	x	0.63	x	0.7	=	38.1	(82)
Rooflights	0.9x	1	x	1	x	150	x	0.63	x	0.7	=	59.53	(82)
Rooflights	0.9x	1	x	1	x	192	x	0.63	x	0.7	=	76.2	(82)
Rooflights	0.9x	1	x	1	x	200	x	0.63	x	0.7	=	79.38	(82)
Rooflights	0.9x	1	x	1	x	189	x	0.63	x	0.7	=	75.01	(82)
Rooflights	0.9x	1	x	1	x	157	x	0.63	x	0.7	=	62.31	(82)
Rooflights	0.9x	1	x	1	x	115	x	0.63	x	0.7	=	45.64	(82)
Rooflights	0.9x	1	x	1	x	66	x	0.63	x	0.7	=	26.2	(82)
Rooflights	0.9x	1	x	1	x	33	x	0.63	x	0.7	=	13.1	(82)
Rooflights	0.9x	1	x	1	x	21	x	0.63	x	0.7	=	8.33	(82)

Solar gains in watts, calculated for each month

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

(83)m=

99.38	191.28	311.54	455.46	563.39	580.01	550.78	468.9	362.11	225.67	123.25	82.21
-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------

 (83)

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

(84)m=

601.04	690.39	793.73	910.35	990.22	980.3	934.19	859.11	766.7	657.8	586.9	569.81
--------	--------	--------	--------	--------	-------	--------	--------	-------	-------	-------	--------

 (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
1	0.99	0.99	0.96	0.9	0.78	0.63	0.69	0.89	0.98	0.99	1

 (86)

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

(87)m=

21	21	21	21	21	21	21	21	21	21	21	21
----	----	----	----	----	----	----	----	----	----	----	----

 (87)

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

(88)m=

19.85	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (88)

DER WorkSheet: New dwelling design stage

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

(89)m=	1	0.99	0.98	0.95	0.86	0.69	0.5	0.56	0.83	0.97	0.99	1	(89)
--------	---	------	------	------	------	------	-----	------	------	------	------	---	------

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

(90)m=	19.85	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = 0.26 \quad (91)$$

Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	20.15	20.15	20.15	20.16	20.16	20.16	20.16	20.16	20.16	20.16	20.15	20.15	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.15	20.15	20.15	20.16	20.16	20.16	20.16	20.16	20.16	20.16	20.15	20.15	(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=	1	0.99	0.98	0.95	0.87	0.72	0.54	0.6	0.85	0.97	0.99	1	(94)
--------	---	------	------	------	------	------	------	-----	------	------	------	---	------

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

(95)m=	598.34	684.8	779.36	865.87	864.64	703.3	500.04	513.8	650.45	637.69	582.25	567.73	(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=	2406.3	2310.99	2064.83	1687.74	1265.99	826.28	529.23	558.28	902.93	1430.65	1960.78	2404.38	(97)
--------	--------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	1345.12	1092.8	956.39	591.75	298.6	0	0	0	0	589.96	992.54	1366.47	(98)
--------	---------	--------	--------	--------	-------	---	---	---	---	--------	--------	---------	------

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1..5,9..12} = 7233.62 \quad (98)$$

Space heating requirement in kWh/m²/year

61.16	(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)
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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

289.17	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

1345.12	1092.8	956.39	591.75	298.6	0	0	0	0	589.96	992.54	1366.47
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$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

465.16	377.9	330.73	204.63	103.26	0	0	0	0	204.02	343.23	472.54
--------	-------	--------	--------	--------	---	---	---	---	--------	--------	--------

$$\text{Total (kWh/year)} = \text{Sum}(211)_{1..5,10..12} = 2501.49 \quad (211)$$

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

213.49	188.06	197.26	176.49	172.7	153.96	147.52	162.35	162.21	183.02	193.96	208.23
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Efficiency of water heater

178.12 (216)

(217)m= 178.12 178.12 178.12 178.12 178.12 178.12 178.12 178.12 178.12 178.12 178.12 178.12 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	119.85	105.58	110.74	99.08	96.96	86.43	82.82	91.14	91.06	102.75	108.89	116.9
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Total = Sum(219a)_{1...12} =

1212.21 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2501.49

Water heating fuel used

1212.21

Electricity for pumps, fans and electric keep-hot

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

0 (231)

Electricity for lighting

492.76 (232)

Electricity generated by PVs

-1709.97 (233)

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

2496.49 (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) x	0.519	=	1298.27 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	629.14 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1927.41 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0 (267)
Electricity for lighting	(232) x	0.519	=	255.74 (268)
Energy saving/generation technologies				
Item 1		0.519	=	-887.47 (269)
Total CO2, kg/year			sum of (265)...(271) =	1295.68 (272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =	10.96 (273)
El rating (section 14)				89 (274)