

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.51
Printed on 09 May 2022 at 12:04:39

Project Information:

Assessed By: Colin Marshall (STRO004020)

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 94.24m²

Site Reference : Flat 3, 74 London Road

Plot Reference: AD-50-01 - SAP Design

Address : Flat 3, 74a London Road, BOGNOR REGIS, PO21 1DD

Client Details:

Name: Ms.T.Paul

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) 25.36 kg/m²

Dwelling Carbon Dioxide Emission Rate (DER) 25.06 kg/m² **OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.9 kWh/m²

Dwelling Fabric Energy Efficiency (DFEE) 50.6 kWh/m² **OK**

2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.67 (max. 0.70)	OK
Party wall	0.05 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.27 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.43 (max. 2.00)	1.60 (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	4.50 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Electric underfloor heating - electric
In timber floor, or immediately below floor covering

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

6 Controls

Space heating controls	Time and temperature zone control	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

Not applicable

9 Summertime temperature

Overheating risk (South East England):	Slight	OK
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Based on:

Overshading:	Average or unknown	
Windows facing: South	8.01m ²	
Windows facing: East	0.56m ²	
Windows facing: West	0.64m ²	
Windows facing: West	1.05m ²	
Ventilation rate:	4.00	
Blinds/curtains:	Dark-coloured curtain or roller blind	
	Closed 100% of daylight hours	

10 Key features

Thermal bridging	0.02 W/m ² K	
Roofs U-value	0.12 W/m ² K	
Party Walls U-value	0 W/m ² K	
Photovoltaic array		

SAP Input

Property Details: AD-50-01 - SAP Design

Address: Flat 3, 74a London Road, BOGNOR REGIS, PO21 1DD
Located in: England
Region: South East England
UPRN: UPRN-100062611158
Date of assessment: 09 May 2022
Date of certificate: 09 May 2022
Assessment type: New dwelling design stage
Transaction type: Not sale or rental
Tenure type: Unknown
Related party disclosure: No related party
Thermal Mass Parameter: Indicative Value Low
Water use <= 125 litres/person/day: True
PCDF Version: 495

Property description:

Dwelling type: Flat
Detachment:
Year Completed: 2022
Floor Location: **Floor area:** **Storey height:**
 Floor 0 16.1 m² 2.868 m
 Floor 1 6.04 m² 3.08 m
 Floor 2 72.1 m² 2.23 m
Living area: 37 m² (fraction 0.393)
Front of dwelling faces: South

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:	
D	Manufacturer	Solid			Wood	
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U	
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U	
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U	
W	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U	
Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
D	mm	0.7	0	1.6	1.8	1
W	16mm or more	0.7	0.63	1.4	8.01	1
W	16mm or more	0.7	0.63	1.4	0.56	1
W	16mm or more	0.7	0.63	1.4	0.64	1
W	16mm or more	0.7	0.63	1.4	1.05	1
Name:	Type-Name:	Location:	Orient:	Width:	Height:	
D		grnd - external	South	0	0	
W		2nd - K-Rend	South	0	0	
W		2nd - K-Rend	East	0	0	
W		2nd- metal cld	West	0	0	
W		First - render	West	0	0	

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Grnd - Bin store	6.66	0	6.66	0.67	0	False	N/A
grnd - external	5.91	1.8	4.11	0.46	0	False	N/A
First - render	23.5	1.05	22.45	0.2	0	False	N/A
First - party Type 2	19.6	0	19.6	0.55	0.9	False	N/A
2nd- metal cld	70.57	0.64	69.93	0.17	0	False	N/A
2nd - K-Rend	48.4	8.57	39.83	0.15	0	False	N/A

SAP Input

roof	72.1	0	72.1	0.12	0	N/A
ground	16.1			0.17		N/A
exposed floor	13.78			0.27		N/A

Internal Elements

Party Elements

ground	26.4					N/A
ground - Unit 2-3	7.84					N/A

Thermal bridges:

Thermal bridges:	User-defined (individual PSI-values) Y-Value = 0.0199				
	Length	Psi-value			
	5.5	1	E1	Steel lintel with perforated steel base plate	

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	0
Pressure test:	4.5

Main heating system:

Main heating system:	Electric underfloor heating
	Standard tariff
	Fuel: Electricity
	Info Source: SAP Tables
	SAP Table: 425
	In timber floor, or immediately below floor covering
	Underfloor heating and radiators, pipes in insulated timber floor
	Central heating pump : 2013 or later
	Boiler interlock: Yes
	MCS Installation Certificate

Main heating Control:

Main heating Control:	Time and temperature zone control
	Control code: 2706

Secondary heating system:

Secondary heating system:	None
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Water heating:

Water heating:	Electric instantaneous at point of use
	Water code: 909
	Fuel :Electricity
	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:	<u>Photovoltaic 1</u>
	Installed Peak power: 1.8

SAP Input

Tilt of collector: 45°
Overshading: None or very little
Collector Orientation: South
No

Assess Zero Carbon Home:

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: Colin Marshall **Stroma Number:** STRO004020
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: AD-50-01 - SAP Design

Address : Flat 3, 74a London Road, BOGNOR REGIS, PO21 1DD

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	16.1 (1a)	x	2.87 (2a)	=	46.17 (3a)
First floor	6.04 (1b)	x	3.08 (2b)	=	18.6 (3b)
Second floor	72.1 (1c)	x	2.23 (2c)	=	160.78 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.24 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	225.56 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	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) =	0.13	(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			4.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.36	(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) =		0.36	(21)
Infiltration rate modified for monthly wind speed				

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

	0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
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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= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (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 1.6	= 2.88		(26)
Windows Type 1			8.01	x1/[1/(1.4)+ 0.04]	= 10.62		(27)
Windows Type 2			0.56	x1/[1/(1.4)+ 0.04]	= 0.74		(27)
Windows Type 3			0.64	x1/[1/(1.4)+ 0.04]	= 0.85		(27)
Windows Type 4			1.05	x1/[1/(1.4)+ 0.04]	= 1.39		(27)
Floor Type 1			16.1	x 0.17	= 2.737		(28)
Floor Type 2			13.78	x 0.27	= 3.7206		(28)
Walls Type1	6.66	0	6.66	x 0.67	= 4.46		(29)
Walls Type2	5.91	1.8	4.11	x 0.46	= 1.89		(29)
Walls Type3	23.5	1.05	22.45	x 0.2	= 4.49		(29)
Walls Type4	19.6	0	19.6	x 0.37	= 7.21		(29)
Walls Type5	70.57	0.64	69.93	x 0.17	= 11.89		(29)
Walls Type6	48.4	8.57	39.83	x 0.15	= 5.97		(29)
Roof	72.1	0	72.1	x 0.12	= 8.65		(30)
Total area of elements, m²			276.62				(31)
Party wall			26.4	x 0	= 0		(32)
Party wall			7.84	x 0.2	= 1.57		(32)

SAP 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) =

69.08

 (33)

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

11125.77

 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) in kJ/m²K Indicative Value: Low

100

 (35)

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

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

5.5

 (36)

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

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

74.58

 (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=	44.97	44.67	44.38	42.99	42.73	41.52	41.52	41.3	41.99	42.73	43.25	43.8	(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=	119.55	119.25	118.95	117.57	117.31	116.1	116.1	115.87	116.56	117.31	117.83	118.38	
Average = $\text{Sum}(39)_{1...12} / 12 =$												117.56	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.27	1.27	1.26	1.25	1.24	1.23	1.23	1.23	1.24	1.24	1.25	1.26	
Average = $\text{Sum}(40)_{1...12} / 12 =$												1.25	(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

2.68

 (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 $TFA \leq 13.9$, $N = 1$

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

97.84

 (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=	107.62	103.71	99.79	95.88	91.97	88.05	88.05	91.97	95.88	99.79	103.71	107.62	
Total = $\text{Sum}(44)_{1...12} =$												1174.04	(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=	159.6	139.58	144.04	125.58	120.49	103.98	96.35	110.56	111.88	130.39	142.33	154.56	
Total = $\text{Sum}(45)_{1...12} =$												1539.35	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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)

SAP WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)												
b) If manufacturer's declared cylinder loss factor is not known:															
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)												
If community heating see section 4.3															
Volume factor from Table 2a		0	(52)												
Temperature factor from Table 2b		0	(53)												
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)												
Enter (50) or (54) in (55)		0	(55)												
Water storage loss calculated for each month	((56)m = (55) x (41)m														
(56)m=		<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	(56)
0	0	0	0	0	0	0	0	0	0	0	0				
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>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	(57)
0	0	0	0	0	0	0	0	0	0	0	0				
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>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	(59)
0	0	0	0	0	0	0	0	0	0	0	0				
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>135.66</td><td>118.65</td><td>122.43</td><td>106.74</td><td>102.42</td><td>88.38</td><td>81.9</td><td>93.98</td><td>95.1</td><td>110.83</td><td>120.98</td><td>131.38</td></tr> </table>	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38	(62)
135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38				
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>135.66</td><td>118.65</td><td>122.43</td><td>106.74</td><td>102.42</td><td>88.38</td><td>81.9</td><td>93.98</td><td>95.1</td><td>110.83</td><td>120.98</td><td>131.38</td></tr> </table>	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38	
135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38				
		Output from water heater (annual) ^{1...12}	1308.44												
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>33.91</td><td>29.66</td><td>30.61</td><td>26.69</td><td>25.6</td><td>22.1</td><td>20.47</td><td>23.49</td><td>23.78</td><td>27.71</td><td>30.25</td><td>32.84</td></tr> </table>	33.91	29.66	30.61	26.69	25.6	22.1	20.47	23.49	23.78	27.71	30.25	32.84	(65)
33.91	29.66	30.61	26.69	25.6	22.1	20.47	23.49	23.78	27.71	30.25	32.84				
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=	160.77	160.77	160.77	160.77	160.77	160.77	160.77	160.77	160.77	160.77	160.77	160.77
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
(67)m=	62.34	55.37	45.03	34.09	25.48	21.51	23.25	30.22	40.56	51.5	60.1	64.07
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
(68)m=	368.16	371.98	362.35	341.86	315.98	291.67	275.43	271.61	281.23	301.73	327.6	351.91
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
(69)m=	53.76	53.76	53.76	53.76	53.76	53.76	53.76	53.76	53.76	53.76	53.76	53.76
Pumps and fans gains (Table 5a)												
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
Losses e.g. evaporation (negative values) (Table 5)												
(71)m=	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18

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Water heating gains (Table 5)

(72)m=

45.58	44.14	41.14	37.06	34.42	30.69	27.52	31.58	33.02	37.24	42.01	44.15
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

583.43	578.83	555.86	520.35	483.23	451.22	433.54	440.74	462.15	497.81	537.05	567.48
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>3.36</td></tr></table>	3.36	(76)
0.77																			
0.56																			
19.64																			
0.63																			
0.7																			
3.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>6.58</td></tr></table>	6.58	(76)
0.77																			
0.56																			
38.42																			
0.63																			
0.7																			
6.58																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>10.83</td></tr></table>	10.83	(76)
0.77																			
0.56																			
63.27																			
0.63																			
0.7																			
10.83																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>15.79</td></tr></table>	15.79	(76)
0.77																			
0.56																			
92.28																			
0.63																			
0.7																			
15.79																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>113.09</td></tr></table>	113.09	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>19.36</td></tr></table>	19.36	(76)
0.77																			
0.56																			
113.09																			
0.63																			
0.7																			
19.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>115.77</td></tr></table>	115.77	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>19.81</td></tr></table>	19.81	(76)
0.77																			
0.56																			
115.77																			
0.63																			
0.7																			
19.81																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>110.22</td></tr></table>	110.22	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>18.86</td></tr></table>	18.86	(76)
0.77																			
0.56																			
110.22																			
0.63																			
0.7																			
18.86																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>94.68</td></tr></table>	94.68	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>16.2</td></tr></table>	16.2	(76)
0.77																			
0.56																			
94.68																			
0.63																			
0.7																			
16.2																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>73.59</td></tr></table>	73.59	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>12.59</td></tr></table>	12.59	(76)
0.77																			
0.56																			
73.59																			
0.63																			
0.7																			
12.59																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>45.59</td></tr></table>	45.59	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>7.8</td></tr></table>	7.8	(76)
0.77																			
0.56																			
45.59																			
0.63																			
0.7																			
7.8																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>24.49</td></tr></table>	24.49	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>4.19</td></tr></table>	4.19	(76)
0.77																			
0.56																			
24.49																			
0.63																			
0.7																			
4.19																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>16.15</td></tr></table>	16.15	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>2.76</td></tr></table>	2.76	(76)
0.77																			
0.56																			
16.15																			
0.63																			
0.7																			
2.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>114.45</td></tr></table>	114.45	(78)
0.77																			
8.01																			
46.75																			
0.63																			
0.7																			
114.45																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>187.44</td></tr></table>	187.44	(78)
0.77																			
8.01																			
76.57																			
0.63																			
0.7																			
187.44																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>238.76</td></tr></table>	238.76	(78)
0.77																			
8.01																			
97.53																			
0.63																			
0.7																			
238.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>269.85</td></tr></table>	269.85	(78)
0.77																			
8.01																			
110.23																			
0.63																			
0.7																			
269.85																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>281.2</td></tr></table>	281.2	(78)
0.77																			
8.01																			
114.87																			
0.63																			
0.7																			
281.2																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>270.62</td></tr></table>	270.62	(78)
0.77																			
8.01																			
110.55																			
0.63																			
0.7																			
270.62																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>264.41</td></tr></table>	264.41	(78)
0.77																			
8.01																			
108.01																			
0.63																			
0.7																			
264.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>256.78</td></tr></table>	256.78	(78)
0.77																			
8.01																			
104.89																			
0.63																			
0.7																			
256.78																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>249.41</td></tr></table>	249.41	(78)
0.77																			
8.01																			
101.89																			
0.63																			
0.7																			
249.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>202.17</td></tr></table>	202.17	(78)
0.77																			
8.01																			
82.59																			
0.63																			
0.7																			
202.17																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>135.66</td></tr></table>	135.66	(78)
0.77																			
8.01																			
55.42																			
0.63																			
0.7																			
135.66																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>98.89</td></tr></table>	98.89	(78)
0.77																			
8.01																			
40.4																			
0.63																			
0.7																			
98.89																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>3.84</td></tr></table>	3.84	(80)
0.77																			
0.64																			
19.64																			
0.63																			
0.7																			
3.84																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>6.3</td></tr></table>	6.3	(80)
0.77																			
1.05																			
19.64																			
0.63																			
0.7																			
6.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>7.51</td></tr></table>	7.51	(80)
0.77																			
0.64																			
38.42																			
0.63																			
0.7																			
7.51																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>12.33</td></tr></table>	12.33	(80)
0.77																			
1.05																			
38.42																			
0.63																			
0.7																			
12.33																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>12.38</td></tr></table>	12.38	(80)
0.77																			
0.64																			
63.27																			
0.63																			
0.7																			
12.38																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>20.3</td></tr></table>	20.3	(80)
0.77																			
1.05																			
63.27																			
0.63																			
0.7																			
20.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>18.05</td></tr></table>	18.05	(80)
0.77																			
0.64																			
92.28																			
0.63																			
0.7																			
18.05																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>29.61</td></tr></table>	29.61	(80)
0.77																			
1.05																			
92.28																			
0.63																			
0.7																			
29.61																			

SAP WorkSheet: New dwelling design stage

West	0.9x	0.77	x	0.64	x	113.09	x	0.63	x	0.7	=	22.12	(80)
West	0.9x	0.77	x	1.05	x	113.09	x	0.63	x	0.7	=	36.29	(80)
West	0.9x	0.77	x	0.64	x	115.77	x	0.63	x	0.7	=	22.64	(80)
West	0.9x	0.77	x	1.05	x	115.77	x	0.63	x	0.7	=	37.15	(80)
West	0.9x	0.77	x	0.64	x	110.22	x	0.63	x	0.7	=	21.56	(80)
West	0.9x	0.77	x	1.05	x	110.22	x	0.63	x	0.7	=	35.37	(80)
West	0.9x	0.77	x	0.64	x	94.68	x	0.63	x	0.7	=	18.52	(80)
West	0.9x	0.77	x	1.05	x	94.68	x	0.63	x	0.7	=	30.38	(80)
West	0.9x	0.77	x	0.64	x	73.59	x	0.63	x	0.7	=	14.39	(80)
West	0.9x	0.77	x	1.05	x	73.59	x	0.63	x	0.7	=	23.61	(80)
West	0.9x	0.77	x	0.64	x	45.59	x	0.63	x	0.7	=	8.92	(80)
West	0.9x	0.77	x	1.05	x	45.59	x	0.63	x	0.7	=	14.63	(80)
West	0.9x	0.77	x	0.64	x	24.49	x	0.63	x	0.7	=	4.79	(80)
West	0.9x	0.77	x	1.05	x	24.49	x	0.63	x	0.7	=	7.86	(80)
West	0.9x	0.77	x	0.64	x	16.15	x	0.63	x	0.7	=	3.16	(80)
West	0.9x	0.77	x	1.05	x	16.15	x	0.63	x	0.7	=	5.18	(80)

Solar gains in watts, calculated for each month

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

(83)m=	127.95	213.85	282.27	333.3	358.97	350.22	340.2	321.88	300.01	233.51	152.5	110	(83)
--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	-------	-----	------

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

(84)m=	711.38	792.69	838.13	853.66	842.19	801.44	773.73	762.62	762.17	731.32	689.55	677.47	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.95	0.93	0.91	0.86	0.8	0.69	0.56	0.58	0.73	0.87	0.93	0.95	(86)

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

(87)m=	18.59	18.84	19.24	19.75	20.23	20.65	20.85	20.83	20.55	19.92	19.17	18.54	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.88	(88)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(89)m=	0.94	0.92	0.89	0.84	0.76	0.61	0.45	0.47	0.67	0.84	0.92	0.95	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	16.69	17.05	17.62	18.34	19.02	19.57	19.8	19.78	19.45	18.6	17.53	16.62	(90)
--------	-------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.39

(91)

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

(92)m=	17.43	17.75	18.25	18.89	19.5	19.99	20.21	20.19	19.88	19.12	18.18	17.38	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	17.43	17.75	18.25	18.89	19.5	19.99	20.21	20.19	19.88	19.12	18.18	17.38	(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=	0.92	0.89	0.86	0.82	0.74	0.62	0.48	0.5	0.67	0.81	0.89	0.92	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

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

(95)m=	652.05	708.73	723.72	696.44	624.93	498.38	372.34	384.7	509.7	595.41	614.65	625.95	(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=	1570.16	1532.83	1397.94	1174.89	914.52	625.71	419.25	439.37	673.63	999.56	1305.31	1559.83	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	683.08	553.79	501.62	344.48	215.46	0	0	0	0	300.69	497.28	694.8	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3791.2 (98)

Space heating requirement in kWh/m²/year

40.23 (99)

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

100 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

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

Space heating requirement (calculated above)

683.08	553.79	501.62	344.48	215.46	0	0	0	0	300.69	497.28	694.8
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

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

(211)

683.08	553.79	501.62	344.48	215.46	0	0	0	0	300.69	497.28	694.8
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	-------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 3791.2 (211)

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)_{1...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38
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Efficiency of water heater

100 (216)

(217)m=	100	100	100	100	100	100	100	100	100	100	100
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38
---------	--------	--------	--------	--------	--------	-------	------	-------	------	--------	--------	--------

Total = Sum(219a)_{1...12} = 1308.44 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

3791.2

Water heating fuel used

1308.44

Electricity for pumps, fans and electric keep-hot

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Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		440.37	(232)
Electricity generated by PVs		-1538.02	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4001.99	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating - main system 1	(211) x	13.19	x 0.01 = 500.06 (240)
Space heating - main system 2	(213) x	0	x 0.01 = 0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 = 0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 = 172.58 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 = 0 (249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a			
Energy for lighting	(232)	13.19	x 0.01 = 58.08 (250)
Additional standing charges (Table 12)			0 (251)
	one of (233) to (235) x	13.19	x 0.01 = -202.87 (252)
Appendix Q items: repeat lines (253) and (254) as needed			
Total energy cost	(245)...(247) + (250)...(254) =		527.86 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.59	(257)
SAP rating (Section 12)		77.79	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating (main system 1)	(211) x	0.519	= 1967.63 (261)
Space heating (secondary)	(215) x	0.519	= 0 (263)
Water heating	(219) x	0.519	= 679.08 (264)
Space and water heating	(261) + (262) + (263) + (264) =		2646.71 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	= 0 (267)
Electricity for lighting	(232) x	0.519	= 228.55 (268)
Energy saving/generation technologies Item 1		0.519	= -798.23 (269)
Total CO2, kg/year		sum of (265)...(271) =	2077.03 (272)
CO2 emissions per m²		(272) ÷ (4) =	22.04 (273)
EI rating (section 14)			80 (274)

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13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year
Space heating (main system 1)	(211) x	3.07	=	11638.98 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	4016.93 (264)
Space and water heating	(261) + (262) + (263) + (264) =			15655.9 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0 (267)
Electricity for lighting	(232) x	0	=	1351.94 (268)
Energy saving/generation technologies Item 1		3.07	=	-4721.73 (269)
'Total Primary Energy		sum of (265)...(271) =		12286.12 (272)
Primary energy kWh/m²/year		(272) ÷ (4) =		130.37 (273)

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User Details:

Assessor Name: Colin Marshall
Software Name: Stroma FSAP 2012

Stroma Number: STRO004020
Software Version: Version: 1.0.5.51

Property Address: AD-50-01 - SAP Design

Address : Flat 3, 74a London Road, BOGNOR REGIS, PO21 1DD

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	16.1 (1a)	x	2.87 (2a)	=	46.17 (3a)
First floor	6.04 (1b)	x	3.08 (2b)	=	18.6 (3b)
Second floor	72.1 (1c)	x	2.23 (2c)	=	160.78 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.24 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	225.56 (5)

2. Ventilation rate:

	main heating	+	secondary heating	+	other	=	total		m ³ 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) =	0.13	(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			4.5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.36	(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) =		0.36	(21)
Infiltration rate modified for monthly wind speed				

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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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

	0.46	0.45	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.4	0.42
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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= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (24d)

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

(25)m= 0.6 0.6 0.6 0.58 0.57 0.56 0.56 0.55 0.56 0.57 0.58 0.59 (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 1.6	= 2.88		(26)
Windows Type 1			8.01	x 1/[1/(1.4)+ 0.04]	= 10.62		(27)
Windows Type 2			0.56	x 1/[1/(1.4)+ 0.04]	= 0.74		(27)
Windows Type 3			0.64	x 1/[1/(1.4)+ 0.04]	= 0.85		(27)
Windows Type 4			1.05	x 1/[1/(1.4)+ 0.04]	= 1.39		(27)
Floor Type 1			16.1	x 0.17	= 2.737		(28)
Floor Type 2			13.78	x 0.27	= 3.7206		(28)
Walls Type1	6.66	0	6.66	x 0.67	= 4.46		(29)
Walls Type2	5.91	1.8	4.11	x 0.46	= 1.89		(29)
Walls Type3	23.5	1.05	22.45	x 0.2	= 4.49		(29)
Walls Type4	19.6	0	19.6	x 0.37	= 7.21		(29)
Walls Type5	70.57	0.64	69.93	x 0.17	= 11.89		(29)
Walls Type6	48.4	8.57	39.83	x 0.15	= 5.97		(29)
Roof	72.1	0	72.1	x 0.12	= 8.65		(30)
Total area of elements, m²			276.62				(31)
Party wall			26.4	x 0	= 0		(32)
Party wall			7.84	x 0.2	= 1.57		(32)

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* 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) = 69.08 (33)

Heat capacity $C_m = S(A \times k)$ ((28)...(30) + (32) + (32a)...(32e) = 11125.77 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : $S(L \times Y)$ calculated using Appendix K 5.5 (36)

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

Total fabric heat loss (33) + (36) = 74.58 (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=	44.97	44.67	44.38	42.99	42.73	41.52	41.52	41.3	41.99	42.73	43.25	43.8	(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=	119.55	119.25	118.95	117.57	117.31	116.1	116.1	115.87	116.56	117.31	117.83	118.38	
Average = Sum(39) _{1...12} /12=												117.56	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.27	1.27	1.26	1.25	1.24	1.23	1.23	1.23	1.24	1.24	1.25	1.26	
Average = Sum(40) _{1...12} /12=												1.25	(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 2.68 (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 $V_{d,average} = (25 \times N) + 36$ 97.84 (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=	107.62	103.71	99.79	95.88	91.97	88.05	88.05	91.97	95.88	99.79	103.71	107.62	
Total = Sum(44) _{1...12} =												1174.04	(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=	159.6	139.58	144.04	125.58	120.49	103.98	96.35	110.56	111.88	130.39	142.33	154.56	
Total = Sum(45) _{1...12} =												1539.35	(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=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)												
b) If manufacturer's declared cylinder loss factor is not known:															
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)												
If community heating see section 4.3															
Volume factor from Table 2a		0	(52)												
Temperature factor from Table 2b		0	(53)												
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)												
Enter (50) or (54) in (55)		0	(55)												
Water storage loss calculated for each month	((56)m = (55) x (41)m														
(56)m=		<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	(56)
0	0	0	0	0	0	0	0	0	0	0	0				
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>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	(57)
0	0	0	0	0	0	0	0	0	0	0	0				
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>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	(59)
0	0	0	0	0	0	0	0	0	0	0	0				
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>135.66</td><td>118.65</td><td>122.43</td><td>106.74</td><td>102.42</td><td>88.38</td><td>81.9</td><td>93.98</td><td>95.1</td><td>110.83</td><td>120.98</td><td>131.38</td></tr> </table>	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38	(62)
135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38				
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>135.66</td><td>118.65</td><td>122.43</td><td>106.74</td><td>102.42</td><td>88.38</td><td>81.9</td><td>93.98</td><td>95.1</td><td>110.83</td><td>120.98</td><td>131.38</td></tr> </table>	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38	
135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38				
		Output from water heater (annual) ^{1...12}	1308.44												
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>33.91</td><td>29.66</td><td>30.61</td><td>26.69</td><td>25.6</td><td>22.1</td><td>20.47</td><td>23.49</td><td>23.78</td><td>27.71</td><td>30.25</td><td>32.84</td></tr> </table>	33.91	29.66	30.61	26.69	25.6	22.1	20.47	23.49	23.78	27.71	30.25	32.84	(65)
33.91	29.66	30.61	26.69	25.6	22.1	20.47	23.49	23.78	27.71	30.25	32.84				
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=	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
(67)m=	24.94	22.15	18.01	13.64	10.19	8.61	9.3	12.09	16.22	20.6	24.04	25.63
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
(68)m=	246.67	249.23	242.78	229.04	211.71	195.42	184.54	181.98	188.43	202.16	219.49	235.78
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
(69)m=	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4
Pumps and fans gains (Table 5a)												
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
Losses e.g. evaporation (negative values) (Table 5)												
(71)m=	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=

45.58	44.14	41.14	37.06	34.42	30.69	27.52	31.58	33.02	37.24	42.01	44.15
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

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

(73)m=

380.38	378.7	365.12	342.93	319.51	297.9	284.54	288.83	300.86	323.19	348.73	368.75
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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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>3.36</td></tr></table>	3.36	(76)
0.77																			
0.56																			
19.64																			
0.63																			
0.7																			
3.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>6.58</td></tr></table>	6.58	(76)
0.77																			
0.56																			
38.42																			
0.63																			
0.7																			
6.58																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>10.83</td></tr></table>	10.83	(76)
0.77																			
0.56																			
63.27																			
0.63																			
0.7																			
10.83																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>15.79</td></tr></table>	15.79	(76)
0.77																			
0.56																			
92.28																			
0.63																			
0.7																			
15.79																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>113.09</td></tr></table>	113.09	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>19.36</td></tr></table>	19.36	(76)
0.77																			
0.56																			
113.09																			
0.63																			
0.7																			
19.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>115.77</td></tr></table>	115.77	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>19.81</td></tr></table>	19.81	(76)
0.77																			
0.56																			
115.77																			
0.63																			
0.7																			
19.81																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>110.22</td></tr></table>	110.22	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>18.86</td></tr></table>	18.86	(76)
0.77																			
0.56																			
110.22																			
0.63																			
0.7																			
18.86																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>94.68</td></tr></table>	94.68	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>16.2</td></tr></table>	16.2	(76)
0.77																			
0.56																			
94.68																			
0.63																			
0.7																			
16.2																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>73.59</td></tr></table>	73.59	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>12.59</td></tr></table>	12.59	(76)
0.77																			
0.56																			
73.59																			
0.63																			
0.7																			
12.59																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>45.59</td></tr></table>	45.59	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>7.8</td></tr></table>	7.8	(76)
0.77																			
0.56																			
45.59																			
0.63																			
0.7																			
7.8																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>24.49</td></tr></table>	24.49	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>4.19</td></tr></table>	4.19	(76)
0.77																			
0.56																			
24.49																			
0.63																			
0.7																			
4.19																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>16.15</td></tr></table>	16.15	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>2.76</td></tr></table>	2.76	(76)
0.77																			
0.56																			
16.15																			
0.63																			
0.7																			
2.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>114.45</td></tr></table>	114.45	(78)
0.77																			
8.01																			
46.75																			
0.63																			
0.7																			
114.45																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>187.44</td></tr></table>	187.44	(78)
0.77																			
8.01																			
76.57																			
0.63																			
0.7																			
187.44																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>238.76</td></tr></table>	238.76	(78)
0.77																			
8.01																			
97.53																			
0.63																			
0.7																			
238.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>269.85</td></tr></table>	269.85	(78)
0.77																			
8.01																			
110.23																			
0.63																			
0.7																			
269.85																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>281.2</td></tr></table>	281.2	(78)
0.77																			
8.01																			
114.87																			
0.63																			
0.7																			
281.2																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>270.62</td></tr></table>	270.62	(78)
0.77																			
8.01																			
110.55																			
0.63																			
0.7																			
270.62																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>264.41</td></tr></table>	264.41	(78)
0.77																			
8.01																			
108.01																			
0.63																			
0.7																			
264.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>256.78</td></tr></table>	256.78	(78)
0.77																			
8.01																			
104.89																			
0.63																			
0.7																			
256.78																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>249.41</td></tr></table>	249.41	(78)
0.77																			
8.01																			
101.89																			
0.63																			
0.7																			
249.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>202.17</td></tr></table>	202.17	(78)
0.77																			
8.01																			
82.59																			
0.63																			
0.7																			
202.17																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>135.66</td></tr></table>	135.66	(78)
0.77																			
8.01																			
55.42																			
0.63																			
0.7																			
135.66																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>98.89</td></tr></table>	98.89	(78)
0.77																			
8.01																			
40.4																			
0.63																			
0.7																			
98.89																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>3.84</td></tr></table>	3.84	(80)
0.77																			
0.64																			
19.64																			
0.63																			
0.7																			
3.84																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>6.3</td></tr></table>	6.3	(80)
0.77																			
1.05																			
19.64																			
0.63																			
0.7																			
6.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>7.51</td></tr></table>	7.51	(80)
0.77																			
0.64																			
38.42																			
0.63																			
0.7																			
7.51																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>12.33</td></tr></table>	12.33	(80)
0.77																			
1.05																			
38.42																			
0.63																			
0.7																			
12.33																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>12.38</td></tr></table>	12.38	(80)
0.77																			
0.64																			
63.27																			
0.63																			
0.7																			
12.38																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>20.3</td></tr></table>	20.3	(80)
0.77																			
1.05																			
63.27																			
0.63																			
0.7																			
20.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>18.05</td></tr></table>	18.05	(80)
0.77																			
0.64																			
92.28																			
0.63																			
0.7																			
18.05																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>29.61</td></tr></table>	29.61	(80)
0.77																			
1.05																			
92.28																			
0.63																			
0.7																			
29.61																			

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	0.64	x	113.09	x	0.63	x	0.7	=	22.12	(80)
West	0.9x	0.77	x	1.05	x	113.09	x	0.63	x	0.7	=	36.29	(80)
West	0.9x	0.77	x	0.64	x	115.77	x	0.63	x	0.7	=	22.64	(80)
West	0.9x	0.77	x	1.05	x	115.77	x	0.63	x	0.7	=	37.15	(80)
West	0.9x	0.77	x	0.64	x	110.22	x	0.63	x	0.7	=	21.56	(80)
West	0.9x	0.77	x	1.05	x	110.22	x	0.63	x	0.7	=	35.37	(80)
West	0.9x	0.77	x	0.64	x	94.68	x	0.63	x	0.7	=	18.52	(80)
West	0.9x	0.77	x	1.05	x	94.68	x	0.63	x	0.7	=	30.38	(80)
West	0.9x	0.77	x	0.64	x	73.59	x	0.63	x	0.7	=	14.39	(80)
West	0.9x	0.77	x	1.05	x	73.59	x	0.63	x	0.7	=	23.61	(80)
West	0.9x	0.77	x	0.64	x	45.59	x	0.63	x	0.7	=	8.92	(80)
West	0.9x	0.77	x	1.05	x	45.59	x	0.63	x	0.7	=	14.63	(80)
West	0.9x	0.77	x	0.64	x	24.49	x	0.63	x	0.7	=	4.79	(80)
West	0.9x	0.77	x	1.05	x	24.49	x	0.63	x	0.7	=	7.86	(80)
West	0.9x	0.77	x	0.64	x	16.15	x	0.63	x	0.7	=	3.16	(80)
West	0.9x	0.77	x	1.05	x	16.15	x	0.63	x	0.7	=	5.18	(80)

Solar gains in watts, calculated for each month

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

(83)m=	127.95	213.85	282.27	333.3	358.97	350.22	340.2	321.88	300.01	233.51	152.5	110	(83)
--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	-------	-----	------

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

(84)m=	508.33	592.56	647.39	676.24	678.48	648.13	624.74	610.71	600.87	556.7	501.23	478.75	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.96	0.94	0.91	0.86	0.76	0.64	0.66	0.81	0.92	0.96	0.98	(86)

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

(87)m=	18.27	18.54	18.97	19.52	20.06	20.54	20.79	20.77	20.41	19.7	18.88	18.22	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(88)m=	19.87	19.87	19.87	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.88	(88)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(89)m=	0.97	0.95	0.93	0.89	0.82	0.7	0.53	0.56	0.75	0.9	0.96	0.97	(89)
--------	------	------	------	------	------	-----	------	------	------	-----	------	------	------

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

(90)m=	16.22	16.61	17.23	18.04	18.81	19.45	19.75	19.72	19.29	18.3	17.12	16.15	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.39

(91)

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

(92)m=	17.02	17.37	17.91	18.62	19.3	19.88	20.16	20.13	19.73	18.85	17.81	16.96	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	17.02	17.37	17.91	18.62	19.3	19.88	20.16	20.13	19.73	18.85	17.81	16.96	(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
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.95	0.93	0.91	0.87	0.8	0.69	0.56	0.58	0.74	0.87	0.94	0.96	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(95)m=	484.96	554.01	588.37	586.89	544.66	450	348.37	356.77	447.64	486.78	469.41	459.36	(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=	1520.86	1486.9	1357.64	1142.66	891.53	612.89	413.46	432.53	656.63	967.69	1262.54	1511.1	(97)
--------	---------	--------	---------	---------	--------	--------	--------	--------	--------	--------	---------	--------	------

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

(98)m=	770.71	626.9	572.34	400.15	258.08	0	0	0	0	357.8	571.06	782.5	(98)
--------	--------	-------	--------	--------	--------	---	---	---	---	-------	--------	-------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

4339.53	(98)
---------	------

Space heating requirement in kWh/m²/year

46.05	(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

100	(206)
-----	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

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

Space heating requirement (calculated above)

770.71	626.9	572.34	400.15	258.08	0	0	0	0	357.8	571.06	782.5
--------	-------	--------	--------	--------	---	---	---	---	-------	--------	-------

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

770.71	626.9	572.34	400.15	258.08	0	0	0	0	357.8	571.06	782.5
--------	-------	--------	--------	--------	---	---	---	---	-------	--------	-------

Total (kWh/year) =Sum(211)_{1...5,10...12} =

4339.53	(211)
---------	-------

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	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	---	-------

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

0	(215)
---	-------

Water heating

Output from water heater (calculated above)

135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38
--------	--------	--------	--------	--------	-------	------	-------	------	--------	--------	--------

Efficiency of water heater

100	(216)
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(217)m=	100	100	100	100	100	100	100	100	100	100	100	(217)
---------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	135.66	118.65	122.43	106.74	102.42	88.38	81.9	93.98	95.1	110.83	120.98	131.38	(219)
---------	--------	--------	--------	--------	--------	-------	------	-------	------	--------	--------	--------	-------

Total = Sum(219a)_{1...12} =

1308.44	(219)
---------	-------

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1

4339.53

Water heating fuel used

1308.44

Electricity for pumps, fans and electric keep-hot

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Total electricity for the above, kWh/year	sum of (230a)...(230g) =	0	(231)
Electricity for lighting		440.37	(232)
Electricity generated by PVs		-1538.02	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4550.33	(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	=	2252.22	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	679.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2931.3	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	228.55	(268)
Energy saving/generation technologies Item 1		0.519	=	-798.23	(269)
Total CO2, kg/year		sum of (265)...(271) =		2361.62	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		25.06	(273)
El rating (section 14)				77	(274)

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User Details:

Assessor Name: Colin Marshall **Stroma Number:** STRO004020
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.5.51

Property Address: AD-50-01 - SAP Design

Address : Flat 3, 74a London Road, BOGNOR REGIS, PO21 1DD

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	16.1 (1a)	x	2.87 (2a)	=	46.17 (3a)
First floor	6.04 (1b)	x	3.08 (2b)	=	18.6 (3b)
Second floor	72.1 (1c)	x	2.23 (2c)	=	160.78 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.24 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	225.56 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 (6a)
Number of open flues	0	+	0	=	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) =	0.13	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
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)
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				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
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) =		0.38	(21)
Infiltration rate modified for monthly wind speed				

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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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

	0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45
--	------	------	------	------	------	------	------	------	------	------	------	------

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
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24a)

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

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

(24b)

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

if (22b)m < 0.5 × (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
---------	---	---	---	---	---	---	---	---	---	---	---	---

(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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6
---------	------	------	------	------	------	------	------	------	------	------	------	-----

(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6
--------	------	------	------	------	------	------	------	------	------	------	------	-----

(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	= 1.8		(26)
Windows Type 1			8.01	x 1/[1/(1.4)+ 0.04]	= 10.62		(27)
Windows Type 2			0.56	x 1/[1/(1.4)+ 0.04]	= 0.74		(27)
Windows Type 3			0.64	x 1/[1/(1.4)+ 0.04]	= 0.85		(27)
Windows Type 4			1.05	x 1/[1/(1.4)+ 0.04]	= 1.39		(27)
Floor Type 1			16.1	x 0.13	= 2.093		(28)
Floor Type 2			13.78	x 0.13	= 1.7914		(28)
Walls Type1	6.66	0	6.66	x 0.18	= 1.2		(29)
Walls Type2	5.91	1.8	4.11	x 0.18	= 0.74		(29)
Walls Type3	23.5	1.05	22.45	x 0.18	= 4.04		(29)
Walls Type4	19.6	0	19.6	x 0.18	= 3.53		(29)
Walls Type5	70.57	0.64	69.93	x 0.18	= 12.59		(29)
Walls Type6	48.4	8.57	39.83	x 0.18	= 7.17		(29)
Roof	72.1	0	72.1	x 0.13	= 9.37		(30)
Total area of elements, m²			276.62				(31)
Party wall			26.4	x 0	= 0		(32)
Party wall			7.84	x 0	= 0		(32)

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* 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) =

57.92

 (33)

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

11125.77

 (34)

Thermal mass parameter (TMP = $C_m \div TFA$) 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 can be used instead of a detailed calculation.

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

0.28

 (36)

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

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

58.2

 (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=	46.09	45.75	45.41	43.82	43.53	42.14	42.14	41.89	42.68	43.53	44.13	44.76	(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=	104.29	103.95	103.61	102.02	101.73	100.34	100.34	100.09	100.88	101.73	102.33	102.95	
Average = $\text{Sum}(39)_{1...12} / 12 =$												102.02	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.11	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.09	1.09	
Average = $\text{Sum}(40)_{1...12} / 12 =$												1.08	(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

2.68

 (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 $TFA \leq 13.9$, $N = 1$

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

97.84

 (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=	107.62	103.71	99.79	95.88	91.97	88.05	88.05	91.97	95.88	99.79	103.71	107.62	
Total = $\text{Sum}(44)_{1...12} =$												1174.04	(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=	159.6	139.58	144.04	125.58	120.49	103.98	96.35	110.56	111.88	130.39	142.33	154.56	
Total = $\text{Sum}(45)_{1...12} =$												1539.35	(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=	23.94	20.94	21.61	18.84	18.07	15.6	14.45	16.58	16.78	19.56	21.35	23.18	(46)

Water storage loss:

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

150

 (47)

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

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

Water storage loss:

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

1.39

 (48)

Temperature factor from Table 2b

0.54

 (49)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(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)		0.75	(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>23.33</td><td>21.07</td><td>23.33</td><td>22.58</td><td>23.33</td><td>22.58</td><td>23.33</td><td>23.33</td><td>22.58</td><td>23.33</td><td>22.58</td><td>23.33</td> </tr> </table>	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)
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33				
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>23.33</td><td>21.07</td><td>23.33</td><td>22.58</td><td>23.33</td><td>22.58</td><td>23.33</td><td>23.33</td><td>22.58</td><td>23.33</td><td>22.58</td><td>23.33</td> </tr> </table>	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)
23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33				
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>206.19</td><td>181.67</td><td>190.63</td><td>170.67</td><td>167.09</td><td>149.07</td><td>142.94</td><td>157.16</td><td>156.98</td><td>176.98</td><td>187.42</td><td>201.16</td> </tr> </table>	206.19	181.67	190.63	170.67	167.09	149.07	142.94	157.16	156.98	176.98	187.42	201.16		(62)
206.19	181.67	190.63	170.67	167.09	149.07	142.94	157.16	156.98	176.98	187.42	201.16				
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>206.19</td><td>181.67</td><td>190.63</td><td>170.67</td><td>167.09</td><td>149.07</td><td>142.94</td><td>157.16</td><td>156.98</td><td>176.98</td><td>187.42</td><td>201.16</td> </tr> </table>	206.19	181.67	190.63	170.67	167.09	149.07	142.94	157.16	156.98	176.98	187.42	201.16		
206.19	181.67	190.63	170.67	167.09	149.07	142.94	157.16	156.98	176.98	187.42	201.16				
											Output from water heater (annual) ^{1...12}	2087.96	(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>90.34</td><td>80.08</td><td>85.17</td><td>77.83</td><td>77.34</td><td>70.65</td><td>69.31</td><td>74.04</td><td>73.27</td><td>80.63</td><td>83.4</td><td>88.67</td> </tr> </table>	90.34	80.08	85.17	77.83	77.34	70.65	69.31	74.04	73.27	80.63	83.4	88.67		(65)
90.34	80.08	85.17	77.83	77.34	70.65	69.31	74.04	73.27	80.63	83.4	88.67				
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=	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	133.97	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.94	22.15	18.01	13.64	10.19	8.61	9.3	12.09	16.22	20.6	24.04	25.63	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	246.67	249.23	242.78	229.04	211.71	195.42	184.54	181.98	188.43	202.16	219.49	235.78	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	(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=	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	-107.18	(71)

TER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=

121.43	119.17	114.47	108.09	103.95	98.12	93.16	99.51	101.77	108.37	115.83	119.18
--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	--------

 (72)

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

(73)m=

459.22	456.73	441.45	416.97	392.05	368.33	353.19	359.77	372.61	397.32	425.55	446.78
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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)							
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>3.36</td></tr></table>	3.36	(76)
0.77																			
0.56																			
19.64																			
0.63																			
0.7																			
3.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>6.58</td></tr></table>	6.58	(76)
0.77																			
0.56																			
38.42																			
0.63																			
0.7																			
6.58																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>10.83</td></tr></table>	10.83	(76)
0.77																			
0.56																			
63.27																			
0.63																			
0.7																			
10.83																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	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>15.79</td></tr></table>	15.79	(76)
0.77																			
0.56																			
92.28																			
0.63																			
0.7																			
15.79																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>113.09</td></tr></table>	113.09	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>19.36</td></tr></table>	19.36	(76)
0.77																			
0.56																			
113.09																			
0.63																			
0.7																			
19.36																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>115.77</td></tr></table>	115.77	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>19.81</td></tr></table>	19.81	(76)
0.77																			
0.56																			
115.77																			
0.63																			
0.7																			
19.81																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>110.22</td></tr></table>	110.22	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>18.86</td></tr></table>	18.86	(76)
0.77																			
0.56																			
110.22																			
0.63																			
0.7																			
18.86																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>94.68</td></tr></table>	94.68	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>16.2</td></tr></table>	16.2	(76)
0.77																			
0.56																			
94.68																			
0.63																			
0.7																			
16.2																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>73.59</td></tr></table>	73.59	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>12.59</td></tr></table>	12.59	(76)
0.77																			
0.56																			
73.59																			
0.63																			
0.7																			
12.59																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>45.59</td></tr></table>	45.59	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>7.8</td></tr></table>	7.8	(76)
0.77																			
0.56																			
45.59																			
0.63																			
0.7																			
7.8																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>24.49</td></tr></table>	24.49	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>4.19</td></tr></table>	4.19	(76)
0.77																			
0.56																			
24.49																			
0.63																			
0.7																			
4.19																			
East	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.56</td></tr></table>	0.56	x	<table><tr><td>16.15</td></tr></table>	16.15	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>2.76</td></tr></table>	2.76	(76)
0.77																			
0.56																			
16.15																			
0.63																			
0.7																			
2.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>114.45</td></tr></table>	114.45	(78)
0.77																			
8.01																			
46.75																			
0.63																			
0.7																			
114.45																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>187.44</td></tr></table>	187.44	(78)
0.77																			
8.01																			
76.57																			
0.63																			
0.7																			
187.44																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>238.76</td></tr></table>	238.76	(78)
0.77																			
8.01																			
97.53																			
0.63																			
0.7																			
238.76																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>269.85</td></tr></table>	269.85	(78)
0.77																			
8.01																			
110.23																			
0.63																			
0.7																			
269.85																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>281.2</td></tr></table>	281.2	(78)
0.77																			
8.01																			
114.87																			
0.63																			
0.7																			
281.2																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>270.62</td></tr></table>	270.62	(78)
0.77																			
8.01																			
110.55																			
0.63																			
0.7																			
270.62																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>264.41</td></tr></table>	264.41	(78)
0.77																			
8.01																			
108.01																			
0.63																			
0.7																			
264.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>256.78</td></tr></table>	256.78	(78)
0.77																			
8.01																			
104.89																			
0.63																			
0.7																			
256.78																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>249.41</td></tr></table>	249.41	(78)
0.77																			
8.01																			
101.89																			
0.63																			
0.7																			
249.41																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>202.17</td></tr></table>	202.17	(78)
0.77																			
8.01																			
82.59																			
0.63																			
0.7																			
202.17																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>135.66</td></tr></table>	135.66	(78)
0.77																			
8.01																			
55.42																			
0.63																			
0.7																			
135.66																			
South	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>8.01</td></tr></table>	8.01	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>98.89</td></tr></table>	98.89	(78)
0.77																			
8.01																			
40.4																			
0.63																			
0.7																			
98.89																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>3.84</td></tr></table>	3.84	(80)
0.77																			
0.64																			
19.64																			
0.63																			
0.7																			
3.84																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>6.3</td></tr></table>	6.3	(80)
0.77																			
1.05																			
19.64																			
0.63																			
0.7																			
6.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>7.51</td></tr></table>	7.51	(80)
0.77																			
0.64																			
38.42																			
0.63																			
0.7																			
7.51																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>12.33</td></tr></table>	12.33	(80)
0.77																			
1.05																			
38.42																			
0.63																			
0.7																			
12.33																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>12.38</td></tr></table>	12.38	(80)
0.77																			
0.64																			
63.27																			
0.63																			
0.7																			
12.38																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>20.3</td></tr></table>	20.3	(80)
0.77																			
1.05																			
63.27																			
0.63																			
0.7																			
20.3																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>0.64</td></tr></table>	0.64	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>18.05</td></tr></table>	18.05	(80)
0.77																			
0.64																			
92.28																			
0.63																			
0.7																			
18.05																			
West	0.9x	<table><tr><td>0.77</td></tr></table>	0.77	x	<table><tr><td>1.05</td></tr></table>	1.05	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>29.61</td></tr></table>	29.61	(80)
0.77																			
1.05																			
92.28																			
0.63																			
0.7																			
29.61																			

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West	0.9x	0.77	x	0.64	x	113.09	x	0.63	x	0.7	=	22.12	(80)
West	0.9x	0.77	x	1.05	x	113.09	x	0.63	x	0.7	=	36.29	(80)
West	0.9x	0.77	x	0.64	x	115.77	x	0.63	x	0.7	=	22.64	(80)
West	0.9x	0.77	x	1.05	x	115.77	x	0.63	x	0.7	=	37.15	(80)
West	0.9x	0.77	x	0.64	x	110.22	x	0.63	x	0.7	=	21.56	(80)
West	0.9x	0.77	x	1.05	x	110.22	x	0.63	x	0.7	=	35.37	(80)
West	0.9x	0.77	x	0.64	x	94.68	x	0.63	x	0.7	=	18.52	(80)
West	0.9x	0.77	x	1.05	x	94.68	x	0.63	x	0.7	=	30.38	(80)
West	0.9x	0.77	x	0.64	x	73.59	x	0.63	x	0.7	=	14.39	(80)
West	0.9x	0.77	x	1.05	x	73.59	x	0.63	x	0.7	=	23.61	(80)
West	0.9x	0.77	x	0.64	x	45.59	x	0.63	x	0.7	=	8.92	(80)
West	0.9x	0.77	x	1.05	x	45.59	x	0.63	x	0.7	=	14.63	(80)
West	0.9x	0.77	x	0.64	x	24.49	x	0.63	x	0.7	=	4.79	(80)
West	0.9x	0.77	x	1.05	x	24.49	x	0.63	x	0.7	=	7.86	(80)
West	0.9x	0.77	x	0.64	x	16.15	x	0.63	x	0.7	=	3.16	(80)
West	0.9x	0.77	x	1.05	x	16.15	x	0.63	x	0.7	=	5.18	(80)

Solar gains in watts, calculated for each month

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

(83)m=	127.95	213.85	282.27	333.3	358.97	350.22	340.2	321.88	300.01	233.51	152.5	110	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	587.17	670.59	723.72	750.27	751.01	718.56	693.38	681.65	672.62	630.84	578.05	556.78	(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	0.97	0.92	0.79	0.61	0.65	0.86	0.97	0.99	1	

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

(87)m=	19.84	19.99	20.21	20.49	20.74	20.93	20.98	20.98	20.88	20.55	20.15	19.82	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.01	20.01	(88)
--------	----	----	----	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.98	0.96	0.89	0.71	0.49	0.52	0.79	0.96	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.45	18.67	18.99	19.4	19.75	19.98	20.02	20.02	19.93	19.5	18.91	18.43	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.39

(91)

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

(92)m=	18.99	19.19	19.47	19.83	20.14	20.35	20.4	20.4	20.3	19.91	19.39	18.97	(92)
--------	-------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	------

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

(93)m=	18.99	19.19	19.47	19.83	20.14	20.35	20.4	20.4	20.3	19.91	19.39	18.97	(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	0.96	0.89	0.74	0.54	0.57	0.81	0.96	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	584.66	664.64	710.14	717.17	669.57	530.13	374.22	390.37	544.63	604.21	572.8	554.95	(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=	1532.49	1485.04	1343.63	1114.99	858.62	576.86	381.4	400.23	625.37	947.12	1258.02	1520.87	(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=	705.19	551.31	471.31	286.43	140.65	0	0	0	0	255.12	493.36	718.65	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3622.03 (98)

Space heating requirement in kWh/m²/year

38.43 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 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
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

705.19	551.31	471.31	286.43	140.65	0	0	0	0	255.12	493.36	718.65
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

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

754.21	589.64	504.08	306.34	150.43	0	0	0	0	272.86	527.66	768.61
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 3873.82 (211)

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

Water heating

Output from water heater (calculated above)

206.19	181.67	190.63	170.67	167.09	149.07	142.94	157.16	156.98	176.98	187.42	201.16
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Efficiency of water heater 79.8 (216)

(217)m=	87.84	87.59	87.14	86.19	84.36	79.8	79.8	79.8	79.8	85.79	87.28	87.92	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	234.75	207.41	218.78	198.03	198.07	186.8	179.13	196.94	196.71	206.3	214.74	228.79	(219)
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Total = Sum(219a)_{1...12} = 2466.45 (219)

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1 3873.82

Water heating fuel used 2466.45

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		440.37	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6855.65	(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		0.216	=	836.75	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	532.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1369.5	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	228.55	(268)
Total CO2, kg/year		sum of (265)...(271) =			1636.98	(272)
 TER =					 25.36	 (273)