

DER WorkSheet: New dwelling design stage

User Details:

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Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 004 - Be Lean

Address : AV 004, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	51.5	(1a) x	2.9	(2a) =	149.35 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.5	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.35 (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							0	x 10 =	0 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08 (21)
Infiltration rate modified for monthly wind speed			

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

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
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 (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
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 (24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
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 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K	
Windows Type 1			10.67	x1/[1/(1.4)+0.04] =	14.15		(27)	
Windows Type 2			2.69	x1/[1/(1.4)+0.04] =	3.57		(27)	
Windows Type 3			1.8	x1/[1/(1.4)+0.04] =	2.39		(27)	
Floor			51.5	x	0.12	=	6.18	(28)
Walls	29.26	15.16	14.1	x	0.12	=	1.69	(29)
Total area of elements, m ²			80.76					(31)
Party wall			53.22	x	0	=	0	(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 27.97 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.93 (36)

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

Total fabric heat loss (33) + (36) = 36.91 (37)

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
11.13	11.03	10.92	10.4	10.29	9.77	9.77	9.67	9.98	10.29	10.5	10.71

 (38)

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

(39)m=

48.04	47.93	47.83	47.3	47.2	46.68	46.68	46.57	46.89	47.2	47.41	47.62
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Average = Sum(39)_{1...12} /12= 47.28 (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.93	0.93	0.93	0.92	0.92	0.91	0.91	0.9	0.91	0.92	0.92	0.92	
Average = Sum(40) _{1...12} / 12 =												0.92	(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

1.73

(42)

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

if TFA ≤ 13.9, N = 1

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

75.39

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

(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93	
Total = Sum(44) _{1...12} =												904.68	(44)

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

(45)m=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1	
Total = Sum(45) _{1...12} =												1186.18	(45)

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

(46)m=	18.45	16.13	16.65	14.51	13.93	12.02	11.14	12.78	12.93	15.07	16.45	17.87	(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

110

(50)

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

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

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

1.03

(54)

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

1.03

(55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	178.26	157.49	166.27	150.26	148.13	133.62	129.52	140.47	139.71	155.75	163.17	174.38	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	178.26	157.49	166.27	150.26	148.13	133.62	129.52	140.47	139.71	155.75	163.17	174.38	
Output from water heater (annual) _{1...12}												(64)	
												1837.02	

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

(65)m=	85.11	75.71	81.13	74.97	75.09	69.44	68.91	72.55	71.46	77.63	79.26	83.82	(65)
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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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	13.47	11.97	9.73	7.37	5.51	4.65	5.02	6.53	8.77	11.13	12.99	13.85	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
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Water heating gains (Table 5)

(72)m=	114.4	112.66	109.04	104.12	100.93	96.44	92.62	97.51	99.25	104.34	110.09	112.66	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	328.02	326.34	316.53	300.84	285.17	269.83	259.72	264.55	272.48	288.34	306.57	319.99	(73)
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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	x	Area m ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	10.67	x	10.63	x	0.4	x	0.8	=	25.16	(74)
North	0.9x		0.77	x	1.8	x	10.63	x	0.4	x	0.8	=	4.24	(74)
North	0.9x		0.77	x	10.67	x	20.32	x	0.4	x	0.8	=	48.08	(74)
North	0.9x		0.77	x	1.8	x	20.32	x	0.4	x	0.8	=	8.11	(74)
North	0.9x		0.77	x	10.67	x	34.53	x	0.4	x	0.8	=	81.7	(74)

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North	0.9x	0.77	x	1.8	x	34.53	x	0.4	x	0.8	=	13.78	(74)
North	0.9x	0.77	x	10.67	x	55.46	x	0.4	x	0.8	=	131.24	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.4	x	0.8	=	22.14	(74)
North	0.9x	0.77	x	10.67	x	74.72	x	0.4	x	0.8	=	176.79	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.4	x	0.8	=	29.82	(74)
North	0.9x	0.77	x	10.67	x	79.99	x	0.4	x	0.8	=	189.26	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.4	x	0.8	=	31.93	(74)
North	0.9x	0.77	x	10.67	x	74.68	x	0.4	x	0.8	=	176.7	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.4	x	0.8	=	29.81	(74)
North	0.9x	0.77	x	10.67	x	59.25	x	0.4	x	0.8	=	140.19	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.4	x	0.8	=	23.65	(74)
North	0.9x	0.77	x	10.67	x	41.52	x	0.4	x	0.8	=	98.24	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.4	x	0.8	=	16.57	(74)
North	0.9x	0.77	x	10.67	x	24.19	x	0.4	x	0.8	=	57.24	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.4	x	0.8	=	9.66	(74)
North	0.9x	0.77	x	10.67	x	13.12	x	0.4	x	0.8	=	31.04	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.4	x	0.8	=	5.24	(74)
North	0.9x	0.77	x	10.67	x	8.86	x	0.4	x	0.8	=	20.98	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.4	x	0.8	=	3.54	(74)
West	0.9x	0.77	x	2.69	x	19.64	x	0.4	x	0.8	=	11.72	(80)
West	0.9x	0.77	x	2.69	x	38.42	x	0.4	x	0.8	=	22.92	(80)
West	0.9x	0.77	x	2.69	x	63.27	x	0.4	x	0.8	=	37.74	(80)
West	0.9x	0.77	x	2.69	x	92.28	x	0.4	x	0.8	=	55.05	(80)
West	0.9x	0.77	x	2.69	x	113.09	x	0.4	x	0.8	=	67.46	(80)
West	0.9x	0.77	x	2.69	x	115.77	x	0.4	x	0.8	=	69.06	(80)
West	0.9x	0.77	x	2.69	x	110.22	x	0.4	x	0.8	=	65.75	(80)
West	0.9x	0.77	x	2.69	x	94.68	x	0.4	x	0.8	=	56.48	(80)
West	0.9x	0.77	x	2.69	x	73.59	x	0.4	x	0.8	=	43.9	(80)
West	0.9x	0.77	x	2.69	x	45.59	x	0.4	x	0.8	=	27.2	(80)
West	0.9x	0.77	x	2.69	x	24.49	x	0.4	x	0.8	=	14.61	(80)
West	0.9x	0.77	x	2.69	x	16.15	x	0.4	x	0.8	=	9.63	(80)

Solar gains in watts, calculated for each month

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

(83)m=	41.12	79.11	133.23	208.43	274.08	290.25	272.26	220.31	158.71	94.09	50.88	34.15	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	369.14	405.45	449.77	509.27	559.25	560.08	531.97	484.87	431.18	382.43	357.45	354.14	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.9	0.74	0.53	0.39	0.44	0.71	0.94	0.99	1	(86)

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

(87)m=	20.17	20.3	20.51	20.79	20.95	20.99	21	21	20.97	20.75	20.42	20.15	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

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

(89)m=	0.99	0.99	0.96	0.88	0.68	0.46	0.31	0.36	0.64	0.92	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.04	19.22	19.53	19.91	20.11	20.16	20.16	20.16	20.14	19.88	19.41	19.01	(90)
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$fLA = \text{Living area} \div (4) =$	0.49	(91)
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Mean internal temperature (for the whole dwelling) = $fLA \times T1 + (1 - fLA) \times T2$

(92)m=	19.59	19.75	20.01	20.34	20.52	20.57	20.57	20.57	20.54	20.3	19.9	19.57	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.59	19.75	20.01	20.34	20.52	20.57	20.57	20.57	20.54	20.3	19.9	19.57	(93)
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8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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=	0.99	0.98	0.96	0.88	0.71	0.49	0.35	0.4	0.67	0.92	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

Useful gains, hmGm , $W = (94)m \times (84)m$

(95)m=	366.08	399.27	432.79	449.46	395.86	276.49	185.11	193.79	290.77	352.97	351.26	351.78	(95)
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Monthly average external temperature from Table 8

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

(97)m=	734.7	711.59	646.21	541.06	416.21	278.46	185.3	194.22	302.04	457.93	606.81	731.74	(97)
--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

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

(98)m=	274.25	209.88	158.78	65.95	15.14	0	0	0	0	78.09	184	282.68	(98)
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$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$	1268.78	(98)
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Space heating requirement in kWh/m²/year

24.64	(99)
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9b. Energy requirements – Community heating scheme

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

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

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

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

Fraction of heat from Community boilers 1 (303a)

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

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

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Space heating

Annual space heating requirement 1268.78

Space heat from Community boilers (98) x (304a) x (305) x (306) = 1395.65 (307a)

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

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

Water heating

Annual water heating requirement 1837.02

If DHW from community scheme:
 Water heat from Community boilers (64) x (303a) x (305) x (306) = 2020.72 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 34.16 (313)

Cooling System Energy Efficiency Ratio 0 (314)

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

Electricity for pumps and fans within dwelling (Table 4f):
 mechanical ventilation - balanced, extract or positive input from outside 113.88 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 113.88 (331)

Energy for lighting (calculated in Appendix L) 237.94 (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel			95
CO2 associated with heat source 1 [(307b)+(310b)] x 100 ÷ (367b) x		0.22	= 776.78
Electrical energy for heat distribution [(313) x		0.52	= 17.73
Total CO2 associated with community systems (363)...(366) + (368)...(372)			= 794.51
CO2 associated with space heating (secondary) (309) x		0	= 0
CO2 associated with water from immersion heater or instantaneous heater (312) x		0.22	= 0
Total CO2 associated with space and water heating (373) + (374) + (375) =			794.51
CO2 associated with electricity for pumps and fans within dwelling (331) x		0.52	= 59.1
CO2 associated with electricity for lighting (332)) x		0.52	= 123.49
Total CO2, kg/year sum of (376)...(382) =			977.1
Dwelling CO2 Emission Rate (383) ÷ (4) =			18.97
EI rating (section 14)			86.43

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
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Calculate effective air change rate for the applicable case

If mechanical ventilation: (23a)

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

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

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

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(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
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(24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(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=

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
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(24d)

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

(25)m=

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
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(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			<input type="text" value="9.06"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="12.01"/>		(27)
Windows Type 2			<input type="text" value="2.28"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="3.02"/>		(27)
Windows Type 3			<input type="text" value="1.53"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.03"/>		(27)
Floor			<input type="text" value="51.5"/>	x <input type="text" value="0.13"/>	$=$ <input type="text" value="6.695"/>	<input type="text"/>	(28)
Walls	<input type="text" value="29.26"/>	<input type="text" value="12.87"/>	<input type="text" value="16.39"/>	x <input type="text" value="0.18"/>	$=$ <input type="text" value="2.95"/>	<input type="text"/>	(29)
Total area of elements, m ²			<input type="text" value="80.76"/>				(31)
Party wall			<input type="text" value="53.22"/>	x <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium (35)

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

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

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

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

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
28.91	28.74	28.58	27.82	27.68	27.01	27.01	26.89	27.27	27.68	27.96	28.27

(38)

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

(39)m=

61.3	61.13	60.97	60.2	60.06	59.4	59.4	59.27	59.65	60.06	60.35	60.65
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Average = Sum(39)_{1...12} /12= (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.19	1.19	1.18	1.17	1.17	1.15	1.15	1.15	1.16	1.17	1.17	1.18		
	Average = Sum(40) _{1...12} / 12 =												1.17	(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 1.73 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 75.39 (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		
<i>Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)</i>														
(44)m=	82.93	79.91	76.9	73.88	70.87	67.85	67.85	70.87	73.88	76.9	79.91	82.93		
	Total = Sum(44) _{1...12} =												904.68	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(45)m=	122.98	107.56	110.99	96.77	92.85	80.12	74.24	85.2	86.21	100.47	109.68	119.1		
	Total = Sum(45) _{1...12} =												1186.18	(45)

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

(46)m= 18.45 16.13 16.65 14.51 13.93 12.02 11.14 12.78 12.93 15.07 16.45 17.87 (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	169.58	149.65	157.59	141.86	139.44	125.21	120.84	131.79	131.31	147.07	154.77	165.7	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	169.58	149.65	157.59	141.86	139.44	125.21	120.84	131.79	131.31	147.07	154.77	165.7		
Output from water heater (annual)_{1...12}												1734.8	(64)	

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

(65)m=	78.17	69.43	74.18	68.25	68.15	62.71	61.96	65.6	64.74	70.68	72.54	76.88	(65)
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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=	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	86.72	(66)

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

(67)m=	13.47	11.97	9.73	7.37	5.51	4.65	5.02	6.53	8.77	11.13	12.99	13.85	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	151.13	152.7	148.74	140.33	129.71	119.73	113.06	111.49	115.45	123.86	134.48	144.46	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	31.67	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	-69.37	(71)
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Water heating gains (Table 5)

(72)m=	105.06	103.32	99.71	94.79	91.6	87.1	83.28	88.18	89.92	95.01	100.75	103.33	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	321.68	320	310.2	294.5	278.83	263.5	253.38	258.22	266.14	282.01	300.23	313.65	(73)
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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 _g Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	9.06	x	10.63	x	0.63	x	0.7	=	29.44	(74)
North	0.9x	0.77	x	1.53	x	10.63	x	0.63	x	0.7	=	4.97	(74)
North	0.9x	0.77	x	9.06	x	20.32	x	0.63	x	0.7	=	56.27	(74)
North	0.9x	0.77	x	1.53	x	20.32	x	0.63	x	0.7	=	9.5	(74)
North	0.9x	0.77	x	9.06	x	34.53	x	0.63	x	0.7	=	95.61	(74)

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North	0.9x	0.77	x	1.53	x	34.53	x	0.63	x	0.7	=	16.15	(74)
North	0.9x	0.77	x	9.06	x	55.46	x	0.63	x	0.7	=	153.57	(74)
North	0.9x	0.77	x	1.53	x	55.46	x	0.63	x	0.7	=	25.93	(74)
North	0.9x	0.77	x	9.06	x	74.72	x	0.63	x	0.7	=	206.88	(74)
North	0.9x	0.77	x	1.53	x	74.72	x	0.63	x	0.7	=	34.94	(74)
North	0.9x	0.77	x	9.06	x	79.99	x	0.63	x	0.7	=	221.47	(74)
North	0.9x	0.77	x	1.53	x	79.99	x	0.63	x	0.7	=	37.4	(74)
North	0.9x	0.77	x	9.06	x	74.68	x	0.63	x	0.7	=	206.77	(74)
North	0.9x	0.77	x	1.53	x	74.68	x	0.63	x	0.7	=	34.92	(74)
North	0.9x	0.77	x	9.06	x	59.25	x	0.63	x	0.7	=	164.04	(74)
North	0.9x	0.77	x	1.53	x	59.25	x	0.63	x	0.7	=	27.7	(74)
North	0.9x	0.77	x	9.06	x	41.52	x	0.63	x	0.7	=	114.95	(74)
North	0.9x	0.77	x	1.53	x	41.52	x	0.63	x	0.7	=	19.41	(74)
North	0.9x	0.77	x	9.06	x	24.19	x	0.63	x	0.7	=	66.98	(74)
North	0.9x	0.77	x	1.53	x	24.19	x	0.63	x	0.7	=	11.31	(74)
North	0.9x	0.77	x	9.06	x	13.12	x	0.63	x	0.7	=	36.32	(74)
North	0.9x	0.77	x	1.53	x	13.12	x	0.63	x	0.7	=	6.13	(74)
North	0.9x	0.77	x	9.06	x	8.86	x	0.63	x	0.7	=	24.54	(74)
North	0.9x	0.77	x	1.53	x	8.86	x	0.63	x	0.7	=	4.14	(74)
West	0.9x	0.77	x	2.28	x	19.64	x	0.63	x	0.7	=	13.69	(80)
West	0.9x	0.77	x	2.28	x	38.42	x	0.63	x	0.7	=	26.77	(80)
West	0.9x	0.77	x	2.28	x	63.27	x	0.63	x	0.7	=	44.09	(80)
West	0.9x	0.77	x	2.28	x	92.28	x	0.63	x	0.7	=	64.3	(80)
West	0.9x	0.77	x	2.28	x	113.09	x	0.63	x	0.7	=	78.8	(80)
West	0.9x	0.77	x	2.28	x	115.77	x	0.63	x	0.7	=	80.67	(80)
West	0.9x	0.77	x	2.28	x	110.22	x	0.63	x	0.7	=	76.8	(80)
West	0.9x	0.77	x	2.28	x	94.68	x	0.63	x	0.7	=	65.97	(80)
West	0.9x	0.77	x	2.28	x	73.59	x	0.63	x	0.7	=	51.28	(80)
West	0.9x	0.77	x	2.28	x	45.59	x	0.63	x	0.7	=	31.77	(80)
West	0.9x	0.77	x	2.28	x	24.49	x	0.63	x	0.7	=	17.06	(80)
West	0.9x	0.77	x	2.28	x	16.15	x	0.63	x	0.7	=	11.25	(80)

Solar gains in watts, calculated for each month

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

(83)m=	48.1	92.54	155.84	243.81	320.62	339.54	318.49	257.72	185.64	110.05	59.52	39.94	(83)
--------	------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	369.78	412.54	466.04	538.31	599.45	603.03	571.87	515.93	451.79	392.06	359.75	353.6	(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=	1	0.99	0.98	0.93	0.8	0.61	0.45	0.52	0.79	0.96	0.99	1	(86)

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

(87)m=	19.81	19.96	20.22	20.59	20.86	20.97	20.99	20.99	20.9	20.55	20.12	19.79	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

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

(88)m=	19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.99	0.97	0.91	0.74	0.52	0.35	0.41	0.71	0.94	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.36	18.58	18.96	19.47	19.82	19.94	19.96	19.96	19.88	19.44	18.83	18.34	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$fLA = \text{Living area} \div (4) =$	0.49	(91)
---------------------------------------	------	------

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

(92)m=	19.07	19.25	19.58	20.02	20.32	20.44	20.46	20.46	20.38	19.98	19.46	19.05	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.07	19.25	19.58	20.02	20.32	20.44	20.46	20.46	20.38	19.98	19.46	19.05	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.91	0.77	0.56	0.4	0.46	0.75	0.94	0.99	0.99	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

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

(95)m=	367.02	407.05	451.57	489.1	459.45	337.53	227.99	237.83	337.35	369.82	354.65	351.45	(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=	905.31	877.17	797.28	669.24	517.99	347.11	229.4	240.65	374.49	563.3	745.86	900.39	(97)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	------

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

(98)m=	400.49	315.92	257.2	129.7	43.56	0	0	0	0	143.94	281.67	408.41	
--------	--------	--------	-------	-------	-------	---	---	---	---	--------	--------	--------	--

$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$	1980.9	(98)
--	--------	------

Space heating requirement in kWh/m²/year

38.46	(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 $(204) = (202) \times [1 - (203)] =$ 1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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

Space heating requirement (calculated above)

400.49	315.92	257.2	129.7	43.56	0	0	0	0	143.94	281.67	408.41
--------	--------	-------	-------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

428.33	337.88	275.08	138.72	46.58	0	0	0	0	153.95	301.25	436.8
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	-------

$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$	2118.61	(211)
---	---------	-------

Space heating fuel (secondary), kWh/month

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

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

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

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Water heating

Output from water heater (calculated above)

169.58	149.65	157.59	141.86	139.44	125.21	120.84	131.79	131.31	147.07	154.77	165.7
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Efficiency of water heater

79.8 (216)

(217)m= 87.03 86.76 86.11 84.58 82.11 79.8 79.8 79.8 79.8 84.76 86.39 87.13 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

194.85	172.48	183	167.73	169.82	156.91	151.43	165.15	164.54	173.52	179.15	190.17
--------	--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

2068.76 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

2118.61

Water heating fuel used

2068.76

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

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

75 (231)

Electricity for lighting

237.94 (232)

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	=	457.62 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	446.85 (264)
Space and water heating	(261) + (262) + (263) + (264) =				904.47 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	123.49 (268)
Total CO2, kg/year	sum of (265)...(271) =				1066.89 (272)

TER = 20.72 (273)

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m=

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

 (24b)

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

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

(24c)m=

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

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

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

 (24d)

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

(25)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			7.91	$x1/[1/(1.4)+0.04] =$	10.49		(27)
Windows Type 2			3.44	$x1/[1/(1.4)+0.04] =$	4.56		(27)
Windows Type 3			4.91	$x1/[1/(1.4)+0.04] =$	6.51		(27)
Windows Type 4			2.69	$x1/[1/(1.4)+0.04] =$	3.57		(27)
Windows Type 5			7.11	$x1/[1/(1.4)+0.04] =$	9.43		(27)
Windows Type 6			3.23	$x1/[1/(1.4)+0.04] =$	4.28		(27)
Windows Type 7			2.75	$x1/[1/(1.4)+0.04] =$	3.65		(27)
Windows Type 8			2.69	$x1/[1/(1.4)+0.04] =$	3.57		(27)
Windows Type 9			1.8	$x1/[1/(1.4)+0.04] =$	2.39		(27)
Windows Type 10			1.8	$x1/[1/(1.4)+0.04] =$	2.39		(27)
Windows Type 11			4.91	$x1/[1/(1.4)+0.04] =$	6.51		(27)
Floor			77.5	x 0.12 =	9.3		(28)
Walls	82.59	43.24	39.35	x 0.12 =	4.72		(29)
Total area of elements, m ²			160.09				(31)
Party wall			19.23	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 71.35 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.75	16.59	16.44	15.65	15.49	14.7	14.7	14.55	15.02	15.49	15.81	16.12	(38)

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

(39)m=	105.86	105.7	105.55	104.76	104.6	103.81	103.81	103.65	104.13	104.6	104.92	105.23	
--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------	--

Average = Sum(39)_{1...12} /12= (39)

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

(40)m=	1.37	1.36	1.36	1.35	1.35	1.34	1.34	1.34	1.34	1.35	1.35	1.36	
--------	------	------	------	------	------	------	------	------	------	------	------	------	--

Average = Sum(40)_{1...12} /12= (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 (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=	100.68	97.02	93.36	89.7	86.03	82.37	82.37	86.03	89.7	93.36	97.02	100.68	

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

Total = Sum(44)_{1...12} = (44)

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

(45)m=	149.3	130.58	134.75	117.48	112.72	97.27	90.14	103.43	104.67	121.98	133.15	144.59	
--------	-------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--

Total = Sum(45)_{1...12} = (45)

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

(46)m=	22.4	19.59	20.21	17.62	16.91	14.59	13.52	15.51	15.7	18.3	19.97	21.69	(46)
--------	------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	------

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

1.03
1.03

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

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(56)

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

(57)m=

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)
 (59)m=

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

(59)

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

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

(61)

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

204.58	180.51	190.03	170.97	168	150.76	145.41	158.71	158.16	177.26	186.64	199.87
--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
 (add additional lines if FGHRHS and/or WWHRHS applies, see Appendix G)
 (63)m=

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

(63)

Output from water heater
 (64)m=

204.58	180.51	190.03	170.97	168	150.76	145.41	158.71	158.16	177.26	186.64	199.87
--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12}

2090.9

(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=

93.86	83.36	89.03	81.86	81.7	75.14	74.19	78.61	77.6	84.78	87.07	92.3
-------	-------	-------	-------	------	-------	-------	-------	------	-------	-------	------

(65)

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

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

Metabolic gains (Table 5), Watts
 (66)m=

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69

(66)

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

19.09	16.96	13.79	10.44	7.8	6.59	7.12	9.25	12.42	15.77	18.41	19.62
-------	-------	-------	-------	-----	------	------	------	-------	-------	-------	-------

(67)

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

214.14	216.36	210.76	198.84	183.79	169.65	160.2	157.98	163.58	175.5	190.55	204.69
--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

(68)

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

35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)
 (70)m=

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

(70)

Losses e.g. evaporation (negative values) (Table 5)
 (71)m=

-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

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

126.16	124.05	119.66	113.69	109.81	104.36	99.72	105.66	107.77	113.95	120.93	124.06
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

(72)

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

418.59	416.57	403.41	382.17	360.61	339.8	326.24	332.1	342.98	364.42	389.08	407.57
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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.

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Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
North	0.9x	7.91	10.63	0.4	0.8	18.65 (74)
North	0.9x	7.11	10.63	0.4	0.8	16.77 (74)
North	0.9x	2.75	10.63	0.4	0.8	6.48 (74)
North	0.9x	2.69	10.63	0.4	0.8	6.34 (74)
North	0.9x	1.8	10.63	0.4	0.8	4.24 (74)
North	0.9x	7.91	20.32	0.4	0.8	35.65 (74)
North	0.9x	7.11	20.32	0.4	0.8	32.04 (74)
North	0.9x	2.75	20.32	0.4	0.8	12.39 (74)
North	0.9x	2.69	20.32	0.4	0.8	12.12 (74)
North	0.9x	1.8	20.32	0.4	0.8	8.11 (74)
North	0.9x	7.91	34.53	0.4	0.8	60.57 (74)
North	0.9x	7.11	34.53	0.4	0.8	54.44 (74)
North	0.9x	2.75	34.53	0.4	0.8	21.06 (74)
North	0.9x	2.69	34.53	0.4	0.8	20.6 (74)
North	0.9x	1.8	34.53	0.4	0.8	13.78 (74)
North	0.9x	7.91	55.46	0.4	0.8	97.29 (74)
North	0.9x	7.11	55.46	0.4	0.8	87.45 (74)
North	0.9x	2.75	55.46	0.4	0.8	33.82 (74)
North	0.9x	2.69	55.46	0.4	0.8	33.09 (74)
North	0.9x	1.8	55.46	0.4	0.8	22.14 (74)
North	0.9x	7.91	74.72	0.4	0.8	131.06 (74)
North	0.9x	7.11	74.72	0.4	0.8	117.81 (74)
North	0.9x	2.75	74.72	0.4	0.8	45.56 (74)
North	0.9x	2.69	74.72	0.4	0.8	44.57 (74)
North	0.9x	1.8	74.72	0.4	0.8	29.82 (74)
North	0.9x	7.91	79.99	0.4	0.8	140.3 (74)
North	0.9x	7.11	79.99	0.4	0.8	126.11 (74)
North	0.9x	2.75	79.99	0.4	0.8	48.78 (74)
North	0.9x	2.69	79.99	0.4	0.8	47.71 (74)
North	0.9x	1.8	79.99	0.4	0.8	31.93 (74)
North	0.9x	7.91	74.68	0.4	0.8	130.99 (74)
North	0.9x	7.11	74.68	0.4	0.8	117.74 (74)
North	0.9x	2.75	74.68	0.4	0.8	45.54 (74)
North	0.9x	2.69	74.68	0.4	0.8	44.55 (74)
North	0.9x	1.8	74.68	0.4	0.8	29.81 (74)
North	0.9x	7.91	59.25	0.4	0.8	103.93 (74)
North	0.9x	7.11	59.25	0.4	0.8	93.41 (74)
North	0.9x	2.75	59.25	0.4	0.8	36.13 (74)
North	0.9x	2.69	59.25	0.4	0.8	35.34 (74)

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North	0.9x	0.77	x	1.8	x	59.25	x	0.4	x	0.8	=	23.65	(74)
North	0.9x	0.77	x	7.91	x	41.52	x	0.4	x	0.8	=	72.83	(74)
North	0.9x	0.77	x	7.11	x	41.52	x	0.4	x	0.8	=	65.46	(74)
North	0.9x	0.77	x	2.75	x	41.52	x	0.4	x	0.8	=	25.32	(74)
North	0.9x	0.77	x	2.69	x	41.52	x	0.4	x	0.8	=	24.77	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.4	x	0.8	=	16.57	(74)
North	0.9x	0.77	x	7.91	x	24.19	x	0.4	x	0.8	=	42.43	(74)
North	0.9x	0.77	x	7.11	x	24.19	x	0.4	x	0.8	=	38.14	(74)
North	0.9x	0.77	x	2.75	x	24.19	x	0.4	x	0.8	=	14.75	(74)
North	0.9x	0.77	x	2.69	x	24.19	x	0.4	x	0.8	=	14.43	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.4	x	0.8	=	9.66	(74)
North	0.9x	0.77	x	7.91	x	13.12	x	0.4	x	0.8	=	23.01	(74)
North	0.9x	0.77	x	7.11	x	13.12	x	0.4	x	0.8	=	20.68	(74)
North	0.9x	0.77	x	2.75	x	13.12	x	0.4	x	0.8	=	8	(74)
North	0.9x	0.77	x	2.69	x	13.12	x	0.4	x	0.8	=	7.83	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.4	x	0.8	=	5.24	(74)
North	0.9x	0.77	x	7.91	x	8.86	x	0.4	x	0.8	=	15.55	(74)
North	0.9x	0.77	x	7.11	x	8.86	x	0.4	x	0.8	=	13.98	(74)
North	0.9x	0.77	x	2.75	x	8.86	x	0.4	x	0.8	=	5.41	(74)
North	0.9x	0.77	x	2.69	x	8.86	x	0.4	x	0.8	=	5.29	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.4	x	0.8	=	3.54	(74)
East	0.9x	0.77	x	3.44	x	19.64	x	0.4	x	0.8	=	14.98	(76)
East	0.9x	0.77	x	4.91	x	19.64	x	0.4	x	0.8	=	21.39	(76)
East	0.9x	0.77	x	2.69	x	19.64	x	0.4	x	0.8	=	11.72	(76)
East	0.9x	0.77	x	3.44	x	38.42	x	0.4	x	0.8	=	29.31	(76)
East	0.9x	0.77	x	4.91	x	38.42	x	0.4	x	0.8	=	41.83	(76)
East	0.9x	0.77	x	2.69	x	38.42	x	0.4	x	0.8	=	22.92	(76)
East	0.9x	0.77	x	3.44	x	63.27	x	0.4	x	0.8	=	48.27	(76)
East	0.9x	0.77	x	4.91	x	63.27	x	0.4	x	0.8	=	68.89	(76)
East	0.9x	0.77	x	2.69	x	63.27	x	0.4	x	0.8	=	37.74	(76)
East	0.9x	0.77	x	3.44	x	92.28	x	0.4	x	0.8	=	70.4	(76)
East	0.9x	0.77	x	4.91	x	92.28	x	0.4	x	0.8	=	100.48	(76)
East	0.9x	0.77	x	2.69	x	92.28	x	0.4	x	0.8	=	55.05	(76)
East	0.9x	0.77	x	3.44	x	113.09	x	0.4	x	0.8	=	86.27	(76)
East	0.9x	0.77	x	4.91	x	113.09	x	0.4	x	0.8	=	123.14	(76)
East	0.9x	0.77	x	2.69	x	113.09	x	0.4	x	0.8	=	67.46	(76)
East	0.9x	0.77	x	3.44	x	115.77	x	0.4	x	0.8	=	88.32	(76)
East	0.9x	0.77	x	4.91	x	115.77	x	0.4	x	0.8	=	126.06	(76)
East	0.9x	0.77	x	2.69	x	115.77	x	0.4	x	0.8	=	69.06	(76)
East	0.9x	0.77	x	3.44	x	110.22	x	0.4	x	0.8	=	84.08	(76)
East	0.9x	0.77	x	4.91	x	110.22	x	0.4	x	0.8	=	120.01	(76)

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East	0.9x	0.77	x	2.69	x	110.22	x	0.4	x	0.8	=	65.75	(76)
East	0.9x	0.77	x	3.44	x	94.68	x	0.4	x	0.8	=	72.22	(76)
East	0.9x	0.77	x	4.91	x	94.68	x	0.4	x	0.8	=	103.09	(76)
East	0.9x	0.77	x	2.69	x	94.68	x	0.4	x	0.8	=	56.48	(76)
East	0.9x	0.77	x	3.44	x	73.59	x	0.4	x	0.8	=	56.14	(76)
East	0.9x	0.77	x	4.91	x	73.59	x	0.4	x	0.8	=	80.13	(76)
East	0.9x	0.77	x	2.69	x	73.59	x	0.4	x	0.8	=	43.9	(76)
East	0.9x	0.77	x	3.44	x	45.59	x	0.4	x	0.8	=	34.78	(76)
East	0.9x	0.77	x	4.91	x	45.59	x	0.4	x	0.8	=	49.64	(76)
East	0.9x	0.77	x	2.69	x	45.59	x	0.4	x	0.8	=	27.2	(76)
East	0.9x	0.77	x	3.44	x	24.49	x	0.4	x	0.8	=	18.68	(76)
East	0.9x	0.77	x	4.91	x	24.49	x	0.4	x	0.8	=	26.66	(76)
East	0.9x	0.77	x	2.69	x	24.49	x	0.4	x	0.8	=	14.61	(76)
East	0.9x	0.77	x	3.44	x	16.15	x	0.4	x	0.8	=	12.32	(76)
East	0.9x	0.77	x	4.91	x	16.15	x	0.4	x	0.8	=	17.59	(76)
East	0.9x	0.77	x	2.69	x	16.15	x	0.4	x	0.8	=	9.63	(76)
South	0.9x	0.77	x	1.8	x	46.75	x	0.4	x	0.8	=	18.66	(78)
South	0.9x	0.77	x	4.91	x	46.75	x	0.4	x	0.8	=	50.91	(78)
South	0.9x	0.77	x	1.8	x	76.57	x	0.4	x	0.8	=	30.56	(78)
South	0.9x	0.77	x	4.91	x	76.57	x	0.4	x	0.8	=	83.37	(78)
South	0.9x	0.77	x	1.8	x	97.53	x	0.4	x	0.8	=	38.93	(78)
South	0.9x	0.77	x	4.91	x	97.53	x	0.4	x	0.8	=	106.2	(78)
South	0.9x	0.77	x	1.8	x	110.23	x	0.4	x	0.8	=	44	(78)
South	0.9x	0.77	x	4.91	x	110.23	x	0.4	x	0.8	=	120.03	(78)
South	0.9x	0.77	x	1.8	x	114.87	x	0.4	x	0.8	=	45.85	(78)
South	0.9x	0.77	x	4.91	x	114.87	x	0.4	x	0.8	=	125.08	(78)
South	0.9x	0.77	x	1.8	x	110.55	x	0.4	x	0.8	=	44.13	(78)
South	0.9x	0.77	x	4.91	x	110.55	x	0.4	x	0.8	=	120.37	(78)
South	0.9x	0.77	x	1.8	x	108.01	x	0.4	x	0.8	=	43.11	(78)
South	0.9x	0.77	x	4.91	x	108.01	x	0.4	x	0.8	=	117.61	(78)
South	0.9x	0.77	x	1.8	x	104.89	x	0.4	x	0.8	=	41.87	(78)
South	0.9x	0.77	x	4.91	x	104.89	x	0.4	x	0.8	=	114.21	(78)
South	0.9x	0.77	x	1.8	x	101.89	x	0.4	x	0.8	=	40.67	(78)
South	0.9x	0.77	x	4.91	x	101.89	x	0.4	x	0.8	=	110.94	(78)
South	0.9x	0.77	x	1.8	x	82.59	x	0.4	x	0.8	=	32.97	(78)
South	0.9x	0.77	x	4.91	x	82.59	x	0.4	x	0.8	=	89.92	(78)
South	0.9x	0.77	x	1.8	x	55.42	x	0.4	x	0.8	=	22.12	(78)
South	0.9x	0.77	x	4.91	x	55.42	x	0.4	x	0.8	=	60.34	(78)
South	0.9x	0.77	x	1.8	x	40.4	x	0.4	x	0.8	=	16.13	(78)
South	0.9x	0.77	x	4.91	x	40.4	x	0.4	x	0.8	=	43.99	(78)
West	0.9x	0.77	x	3.23	x	19.64	x	0.4	x	0.8	=	14.07	(80)

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West	0.9x	0.77	x	3.23	x	38.42	x	0.4	x	0.8	=	27.52	(80)
West	0.9x	0.77	x	3.23	x	63.27	x	0.4	x	0.8	=	45.32	(80)
West	0.9x	0.77	x	3.23	x	92.28	x	0.4	x	0.8	=	66.1	(80)
West	0.9x	0.77	x	3.23	x	113.09	x	0.4	x	0.8	=	81.01	(80)
West	0.9x	0.77	x	3.23	x	115.77	x	0.4	x	0.8	=	82.92	(80)
West	0.9x	0.77	x	3.23	x	110.22	x	0.4	x	0.8	=	78.95	(80)
West	0.9x	0.77	x	3.23	x	94.68	x	0.4	x	0.8	=	67.81	(80)
West	0.9x	0.77	x	3.23	x	73.59	x	0.4	x	0.8	=	52.71	(80)
West	0.9x	0.77	x	3.23	x	45.59	x	0.4	x	0.8	=	32.65	(80)
West	0.9x	0.77	x	3.23	x	24.49	x	0.4	x	0.8	=	17.54	(80)
West	0.9x	0.77	x	3.23	x	16.15	x	0.4	x	0.8	=	11.57	(80)

Solar gains in watts, calculated for each month

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

(83)m=	184.21	335.83	515.81	729.85	897.64	925.69	878.14	748.15	589.42	386.56	224.71	154.98	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	602.8	752.4	919.23	1112.02	1258.25	1265.49	1204.39	1080.25	932.4	750.99	613.79	562.55	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.86	0.7	0.51	0.38	0.43	0.7	0.93	0.99	1	(86)

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

(87)m=	19.64	19.88	20.24	20.64	20.89	20.98	21	20.99	20.92	20.55	20	19.59	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.79	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.8	19.8	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.83	0.63	0.42	0.28	0.33	0.6	0.9	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.01	18.36	18.87	19.42	19.71	19.8	19.81	19.81	19.75	19.31	18.55	17.95	(90)
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fLA = Living area ÷ (4) =

0.37

(91)

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

(92)m=	18.61	18.92	19.37	19.87	20.14	20.23	20.24	20.24	20.18	19.76	19.08	18.55	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.61	18.92	19.37	19.87	20.14	20.23	20.24	20.24	20.18	19.76	19.08	18.55	(93)
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8. Space heating requirement

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

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

(94)m=	0.99	0.97	0.93	0.83	0.65	0.45	0.31	0.37	0.63	0.9	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	596.4	733.05	858.58	921.55	818.79	574.3	376.76	395.33	591.74	675.87	600.31	557.99	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	1514.53	1481.66	1358.66	1148.9	883.02	584.51	378.25	398.27	633.12	958.59	1257.23	1509.86	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	683.09	503.07	372.06	163.69	47.79	0	0	0	0	210.35	472.98	708.19	
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Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12} =$ 3161.22 (98)

Space heating requirement in kWh/m²/year 40.79 (99)

9b. Energy requirements – Community heating scheme

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

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

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

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

Fraction of heat from Community boilers 1 (303a)

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

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

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Space heating

Annual space heating requirement 3161.22 kWh/year

Space heat from Community boilers (98) x (304a) x (305) x (306) = 3477.34 (307a)

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

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

Water heating

Annual water heating requirement 2090.9 kWh/year

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2299.99 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 57.77 (313)

Cooling System Energy Efficiency Ratio 0 (314)

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

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside 171.37 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 171.37 (331)

Energy for lighting (calculated in Appendix L) 337.14 (332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%) <small>If there is CHP using two fuels repeat (363) to (366) for the second fuel</small>			95 (367a)

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CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.22	=	1313.58	(367)
Electrical energy for heat distribution	$[(313) \times$	0.52	=	29.98	(372)
Total CO2 associated with community systems	$(363)...(366) + (368)...(372)$		=	1343.57	(373)
CO2 associated with space heating (secondary)	$(309) \times$	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	=	0	(375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$			1343.57	(376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	=	88.94	(378)
CO2 associated with electricity for lighting	$(332))) \times$	0.52	=	174.98	(379)
Total CO2, kg/year	sum of (376)...(382) =			1607.49	(383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$			20.74	(384)
EI rating (section 14)				82.42	(385)

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

0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.38
------	------	-----	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

(24a)m=

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

 (24a)

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

(24b)m=

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

 (24b)

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

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

(24c)m=

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

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
------	------	------	------	------	------	------	------	------	------	------	------

 (24d)

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

(25)m=

0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57
------	------	------	------	------	------	------	------	------	------	------	------

 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K	
Windows Type 1			3.54	x1/[1/(1.4)+ 0.04] =	4.69		(27)	
Windows Type 2			1.54	x1/[1/(1.4)+ 0.04] =	2.04		(27)	
Windows Type 3			2.2	x1/[1/(1.4)+ 0.04] =	2.92		(27)	
Windows Type 4			1.21	x1/[1/(1.4)+ 0.04] =	1.6		(27)	
Windows Type 5			3.19	x1/[1/(1.4)+ 0.04] =	4.23		(27)	
Windows Type 6			1.45	x1/[1/(1.4)+ 0.04] =	1.92		(27)	
Windows Type 7			1.23	x1/[1/(1.4)+ 0.04] =	1.63		(27)	
Windows Type 8			1.21	x1/[1/(1.4)+ 0.04] =	1.6		(27)	
Windows Type 9			0.81	x1/[1/(1.4)+ 0.04] =	1.07		(27)	
Windows Type 10			0.81	x1/[1/(1.4)+ 0.04] =	1.07		(27)	
Windows Type 11			2.2	x1/[1/(1.4)+ 0.04] =	2.92		(27)	
Floor			77.5	x	0.13	=	10.075	(28)
Walls	82.59	19.39	63.2	x	0.18	=	11.38	(29)
Total area of elements, m ²			160.09					(31)
Party wall			19.23	x	0	=	0	(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 47.16 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	43.49	43.24	43	41.85	41.64	40.64	40.64	40.46	41.02	41.64	42.07	42.52	(38)

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

(39)m=	102.94	102.7	102.45	101.31	101.09	100.09	100.09	99.91	100.48	101.09	101.53	101.98	
--------	--------	-------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--

Average = Sum(39)_{1...12} / 12 = (39)

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

(40)m=	1.33	1.33	1.32	1.31	1.3	1.29	1.29	1.29	1.3	1.3	1.31	1.32	
--------	------	------	------	------	-----	------	------	------	-----	-----	------	------	--

Average = Sum(40)_{1...12} / 12 = (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 (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=	100.68	97.02	93.36	89.7	86.03	82.37	82.37	86.03	89.7	93.36	97.02	100.68	

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

Total = Sum(44)_{1...12} = (44)

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

(45)m=	149.3	130.58	134.75	117.48	112.72	97.27	90.14	103.43	104.67	121.98	133.15	144.59	
--------	-------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--

Total = Sum(45)_{1...12} = (45)

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

(46)m=	22.4	19.59	20.21	17.62	16.91	14.59	13.52	15.51	15.7	18.3	19.97	21.69	
--------	------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	--

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a (52)

Temperature factor from Table 2b (53)

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

0
0.75

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

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

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

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

(57)m=

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

(57)

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=

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

(59)

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

(61)m=

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

(61)

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

(62)m=

195.9	172.67	181.34	162.57	159.32	142.36	136.73	150.03	149.76	168.57	178.24	191.19
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)
 (add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=

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

(63)

Output from water heater

(64)m=

195.9	172.67	181.34	162.57	159.32	142.36	136.73	150.03	149.76	168.57	178.24	191.19
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(64)

Output from water heater (annual)_{1...12}

1988.67

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

(65)m=

86.92	77.09	82.08	75.13	74.76	68.42	67.25	71.67	70.88	77.83	80.35	85.35
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(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69	120.69

(66)

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

(67)m=

19.09	16.96	13.79	10.44	7.8	6.59	7.12	9.25	12.42	15.77	18.41	19.62
-------	-------	-------	-------	-----	------	------	------	-------	-------	-------	-------

(67)

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

(68)m=

214.14	216.36	210.76	198.84	183.79	169.65	160.2	157.98	163.58	175.5	190.55	204.69
--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

(68)

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

(69)m=

35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07	35.07
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=

-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55	-96.55
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=

116.83	114.71	110.32	104.35	100.48	95.02	90.38	96.33	98.44	104.62	111.59	114.72
--------	--------	--------	--------	--------	-------	-------	-------	-------	--------	--------	--------

(72)

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

(73)m=

412.26	410.23	397.08	375.84	354.28	333.46	319.91	325.76	336.64	358.09	382.75	401.24
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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.

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Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)							
North	0.9x	0.77	x	3.54	x	10.63	x	0.63	x	0.7	=	11.5	(74)
North	0.9x	0.77	x	3.19	x	10.63	x	0.63	x	0.7	=	10.37	(74)
North	0.9x	0.77	x	1.23	x	10.63	x	0.63	x	0.7	=	4	(74)
North	0.9x	0.77	x	1.21	x	10.63	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	0.81	x	10.63	x	0.63	x	0.7	=	2.63	(74)
North	0.9x	0.77	x	3.54	x	20.32	x	0.63	x	0.7	=	21.98	(74)
North	0.9x	0.77	x	3.19	x	20.32	x	0.63	x	0.7	=	19.81	(74)
North	0.9x	0.77	x	1.23	x	20.32	x	0.63	x	0.7	=	7.64	(74)
North	0.9x	0.77	x	1.21	x	20.32	x	0.63	x	0.7	=	7.51	(74)
North	0.9x	0.77	x	0.81	x	20.32	x	0.63	x	0.7	=	5.03	(74)
North	0.9x	0.77	x	3.54	x	34.53	x	0.63	x	0.7	=	37.36	(74)
North	0.9x	0.77	x	3.19	x	34.53	x	0.63	x	0.7	=	33.66	(74)
North	0.9x	0.77	x	1.23	x	34.53	x	0.63	x	0.7	=	12.98	(74)
North	0.9x	0.77	x	1.21	x	34.53	x	0.63	x	0.7	=	12.77	(74)
North	0.9x	0.77	x	0.81	x	34.53	x	0.63	x	0.7	=	8.55	(74)
North	0.9x	0.77	x	3.54	x	55.46	x	0.63	x	0.7	=	60.01	(74)
North	0.9x	0.77	x	3.19	x	55.46	x	0.63	x	0.7	=	54.07	(74)
North	0.9x	0.77	x	1.23	x	55.46	x	0.63	x	0.7	=	20.85	(74)
North	0.9x	0.77	x	1.21	x	55.46	x	0.63	x	0.7	=	20.51	(74)
North	0.9x	0.77	x	0.81	x	55.46	x	0.63	x	0.7	=	13.73	(74)
North	0.9x	0.77	x	3.54	x	74.72	x	0.63	x	0.7	=	80.83	(74)
North	0.9x	0.77	x	3.19	x	74.72	x	0.63	x	0.7	=	72.84	(74)
North	0.9x	0.77	x	1.23	x	74.72	x	0.63	x	0.7	=	28.09	(74)
North	0.9x	0.77	x	1.21	x	74.72	x	0.63	x	0.7	=	27.63	(74)
North	0.9x	0.77	x	0.81	x	74.72	x	0.63	x	0.7	=	18.5	(74)
North	0.9x	0.77	x	3.54	x	79.99	x	0.63	x	0.7	=	86.53	(74)
North	0.9x	0.77	x	3.19	x	79.99	x	0.63	x	0.7	=	77.98	(74)
North	0.9x	0.77	x	1.23	x	79.99	x	0.63	x	0.7	=	30.07	(74)
North	0.9x	0.77	x	1.21	x	79.99	x	0.63	x	0.7	=	29.58	(74)
North	0.9x	0.77	x	0.81	x	79.99	x	0.63	x	0.7	=	19.8	(74)
North	0.9x	0.77	x	3.54	x	74.68	x	0.63	x	0.7	=	80.79	(74)
North	0.9x	0.77	x	3.19	x	74.68	x	0.63	x	0.7	=	72.8	(74)
North	0.9x	0.77	x	1.23	x	74.68	x	0.63	x	0.7	=	28.07	(74)
North	0.9x	0.77	x	1.21	x	74.68	x	0.63	x	0.7	=	27.61	(74)
North	0.9x	0.77	x	0.81	x	74.68	x	0.63	x	0.7	=	18.49	(74)
North	0.9x	0.77	x	3.54	x	59.25	x	0.63	x	0.7	=	64.1	(74)
North	0.9x	0.77	x	3.19	x	59.25	x	0.63	x	0.7	=	57.76	(74)
North	0.9x	0.77	x	1.23	x	59.25	x	0.63	x	0.7	=	22.27	(74)
North	0.9x	0.77	x	1.21	x	59.25	x	0.63	x	0.7	=	21.91	(74)

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North	0.9x	0.77	x	0.81	x	59.25	x	0.63	x	0.7	=	14.67	(74)
North	0.9x	0.77	x	3.54	x	41.52	x	0.63	x	0.7	=	44.92	(74)
North	0.9x	0.77	x	3.19	x	41.52	x	0.63	x	0.7	=	40.47	(74)
North	0.9x	0.77	x	1.23	x	41.52	x	0.63	x	0.7	=	15.61	(74)
North	0.9x	0.77	x	1.21	x	41.52	x	0.63	x	0.7	=	15.35	(74)
North	0.9x	0.77	x	0.81	x	41.52	x	0.63	x	0.7	=	10.28	(74)
North	0.9x	0.77	x	3.54	x	24.19	x	0.63	x	0.7	=	26.17	(74)
North	0.9x	0.77	x	3.19	x	24.19	x	0.63	x	0.7	=	23.58	(74)
North	0.9x	0.77	x	1.23	x	24.19	x	0.63	x	0.7	=	9.09	(74)
North	0.9x	0.77	x	1.21	x	24.19	x	0.63	x	0.7	=	8.95	(74)
North	0.9x	0.77	x	0.81	x	24.19	x	0.63	x	0.7	=	5.99	(74)
North	0.9x	0.77	x	3.54	x	13.12	x	0.63	x	0.7	=	14.19	(74)
North	0.9x	0.77	x	3.19	x	13.12	x	0.63	x	0.7	=	12.79	(74)
North	0.9x	0.77	x	1.23	x	13.12	x	0.63	x	0.7	=	4.93	(74)
North	0.9x	0.77	x	1.21	x	13.12	x	0.63	x	0.7	=	4.85	(74)
North	0.9x	0.77	x	0.81	x	13.12	x	0.63	x	0.7	=	3.25	(74)
North	0.9x	0.77	x	3.54	x	8.86	x	0.63	x	0.7	=	9.59	(74)
North	0.9x	0.77	x	3.19	x	8.86	x	0.63	x	0.7	=	8.64	(74)
North	0.9x	0.77	x	1.23	x	8.86	x	0.63	x	0.7	=	3.33	(74)
North	0.9x	0.77	x	1.21	x	8.86	x	0.63	x	0.7	=	3.28	(74)
North	0.9x	0.77	x	0.81	x	8.86	x	0.63	x	0.7	=	2.19	(74)
East	0.9x	0.77	x	1.54	x	19.64	x	0.63	x	0.7	=	9.24	(76)
East	0.9x	0.77	x	2.2	x	19.64	x	0.63	x	0.7	=	13.21	(76)
East	0.9x	0.77	x	1.21	x	19.64	x	0.63	x	0.7	=	7.26	(76)
East	0.9x	0.77	x	1.54	x	38.42	x	0.63	x	0.7	=	18.08	(76)
East	0.9x	0.77	x	2.2	x	38.42	x	0.63	x	0.7	=	25.83	(76)
East	0.9x	0.77	x	1.21	x	38.42	x	0.63	x	0.7	=	14.21	(76)
East	0.9x	0.77	x	1.54	x	63.27	x	0.63	x	0.7	=	29.78	(76)
East	0.9x	0.77	x	2.2	x	63.27	x	0.63	x	0.7	=	42.54	(76)
East	0.9x	0.77	x	1.21	x	63.27	x	0.63	x	0.7	=	23.4	(76)
East	0.9x	0.77	x	1.54	x	92.28	x	0.63	x	0.7	=	43.43	(76)
East	0.9x	0.77	x	2.2	x	92.28	x	0.63	x	0.7	=	62.04	(76)
East	0.9x	0.77	x	1.21	x	92.28	x	0.63	x	0.7	=	34.12	(76)
East	0.9x	0.77	x	1.54	x	113.09	x	0.63	x	0.7	=	53.23	(76)
East	0.9x	0.77	x	2.2	x	113.09	x	0.63	x	0.7	=	76.04	(76)
East	0.9x	0.77	x	1.21	x	113.09	x	0.63	x	0.7	=	41.82	(76)
East	0.9x	0.77	x	1.54	x	115.77	x	0.63	x	0.7	=	54.49	(76)
East	0.9x	0.77	x	2.2	x	115.77	x	0.63	x	0.7	=	77.84	(76)
East	0.9x	0.77	x	1.21	x	115.77	x	0.63	x	0.7	=	42.81	(76)
East	0.9x	0.77	x	1.54	x	110.22	x	0.63	x	0.7	=	51.87	(76)
East	0.9x	0.77	x	2.2	x	110.22	x	0.63	x	0.7	=	74.11	(76)

TER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	1.21	x	110.22	x	0.63	x	0.7	=	40.76	(76)
East	0.9x	0.77	x	1.54	x	94.68	x	0.63	x	0.7	=	44.56	(76)
East	0.9x	0.77	x	2.2	x	94.68	x	0.63	x	0.7	=	63.66	(76)
East	0.9x	0.77	x	1.21	x	94.68	x	0.63	x	0.7	=	35.01	(76)
East	0.9x	0.77	x	1.54	x	73.59	x	0.63	x	0.7	=	34.63	(76)
East	0.9x	0.77	x	2.2	x	73.59	x	0.63	x	0.7	=	49.48	(76)
East	0.9x	0.77	x	1.21	x	73.59	x	0.63	x	0.7	=	27.21	(76)
East	0.9x	0.77	x	1.54	x	45.59	x	0.63	x	0.7	=	21.46	(76)
East	0.9x	0.77	x	2.2	x	45.59	x	0.63	x	0.7	=	30.65	(76)
East	0.9x	0.77	x	1.21	x	45.59	x	0.63	x	0.7	=	16.86	(76)
East	0.9x	0.77	x	1.54	x	24.49	x	0.63	x	0.7	=	11.53	(76)
East	0.9x	0.77	x	2.2	x	24.49	x	0.63	x	0.7	=	16.47	(76)
East	0.9x	0.77	x	1.21	x	24.49	x	0.63	x	0.7	=	9.06	(76)
East	0.9x	0.77	x	1.54	x	16.15	x	0.63	x	0.7	=	7.6	(76)
East	0.9x	0.77	x	2.2	x	16.15	x	0.63	x	0.7	=	10.86	(76)
East	0.9x	0.77	x	1.21	x	16.15	x	0.63	x	0.7	=	5.97	(76)
South	0.9x	0.77	x	0.81	x	46.75	x	0.63	x	0.7	=	11.57	(78)
South	0.9x	0.77	x	2.2	x	46.75	x	0.63	x	0.7	=	31.43	(78)
South	0.9x	0.77	x	0.81	x	76.57	x	0.63	x	0.7	=	18.95	(78)
South	0.9x	0.77	x	2.2	x	76.57	x	0.63	x	0.7	=	51.48	(78)
South	0.9x	0.77	x	0.81	x	97.53	x	0.63	x	0.7	=	24.14	(78)
South	0.9x	0.77	x	2.2	x	97.53	x	0.63	x	0.7	=	65.58	(78)
South	0.9x	0.77	x	0.81	x	110.23	x	0.63	x	0.7	=	27.29	(78)
South	0.9x	0.77	x	2.2	x	110.23	x	0.63	x	0.7	=	74.12	(78)
South	0.9x	0.77	x	0.81	x	114.87	x	0.63	x	0.7	=	28.44	(78)
South	0.9x	0.77	x	2.2	x	114.87	x	0.63	x	0.7	=	77.23	(78)
South	0.9x	0.77	x	0.81	x	110.55	x	0.63	x	0.7	=	27.37	(78)
South	0.9x	0.77	x	2.2	x	110.55	x	0.63	x	0.7	=	74.33	(78)
South	0.9x	0.77	x	0.81	x	108.01	x	0.63	x	0.7	=	26.74	(78)
South	0.9x	0.77	x	2.2	x	108.01	x	0.63	x	0.7	=	72.62	(78)
South	0.9x	0.77	x	0.81	x	104.89	x	0.63	x	0.7	=	25.97	(78)
South	0.9x	0.77	x	2.2	x	104.89	x	0.63	x	0.7	=	70.53	(78)
South	0.9x	0.77	x	0.81	x	101.89	x	0.63	x	0.7	=	25.22	(78)
South	0.9x	0.77	x	2.2	x	101.89	x	0.63	x	0.7	=	68.5	(78)
South	0.9x	0.77	x	0.81	x	82.59	x	0.63	x	0.7	=	20.44	(78)
South	0.9x	0.77	x	2.2	x	82.59	x	0.63	x	0.7	=	55.53	(78)
South	0.9x	0.77	x	0.81	x	55.42	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	2.2	x	55.42	x	0.63	x	0.7	=	37.26	(78)
South	0.9x	0.77	x	0.81	x	40.4	x	0.63	x	0.7	=	10	(78)
South	0.9x	0.77	x	2.2	x	40.4	x	0.63	x	0.7	=	27.16	(78)
West	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	8.7	(80)

TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	17.03	(80)
West	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	28.04	(80)
West	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	40.89	(80)
West	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	50.12	(80)
West	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	51.3	(80)
West	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	48.84	(80)
West	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	41.95	(80)
West	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	32.61	(80)
West	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	20.2	(80)
West	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	10.85	(80)
West	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	7.16	(80)

Solar gains in watts, calculated for each month

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

(83)m=	113.85	207.56	318.8	451.06	554.75	572.09	542.7	462.37	364.29	238.92	138.89	95.79	(83)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	-------	------

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

(84)m=	526.11	617.79	715.87	826.9	909.03	905.55	862.61	788.14	700.93	597.01	521.63	497.03	(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	0.98	0.94	0.83	0.66	0.5	0.56	0.82	0.97	0.99	1	

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

(87)m=	19.6	19.78	20.08	20.47	20.78	20.95	20.99	20.98	20.86	20.44	19.95	19.57	(87)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	19.82	19.82	19.82	19.84	19.84	19.85	19.85	19.85	19.84	19.84	19.83	19.83	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.97	0.92	0.78	0.56	0.37	0.43	0.73	0.95	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	17.97	18.24	18.67	19.23	19.64	19.81	19.84	19.84	19.73	19.2	18.49	17.94	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.37

(91)

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

(92)m=	18.57	18.8	19.19	19.69	20.06	20.23	20.26	20.26	20.15	19.66	19.03	18.53	(92)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.57	18.8	19.19	19.69	20.06	20.23	20.26	20.26	20.15	19.66	19.03	18.53	(93)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.97	0.91	0.79	0.59	0.42	0.48	0.76	0.95	0.99	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	522.72	609.59	693.09	754.77	716.8	537.46	362.43	378.01	530.8	564.26	515.05	494.51	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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TER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, $Lm, W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1468.82	1427.68	1299.96	1092.6	844.82	563.48	366.64	385.54	607.44	915.52	1210.91	1461.75	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	703.89	549.76	451.51	243.24	95.25	0	0	0	0	261.34	501.02	719.63	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12} =$ 3525.63 (98)

Space heating requirement in kWh/m²/year 45.49 (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)

703.89	549.76	451.51	243.24	95.25	0	0	0	0	261.34	501.02	719.63
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

752.83	587.98	482.9	260.15	101.87	0	0	0	0	279.51	535.85	769.65
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Total (kWh/year) = $\text{Sum}(211)_{1...5,10...12} =$ 3770.73 (211)

Space heating fuel (secondary), kWh/month

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

(215)m=

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

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

Water heating

Output from water heater (calculated above)

195.9	172.67	181.34	162.57	159.32	142.36	136.73	150.03	149.76	168.57	178.24	191.19
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Efficiency of water heater 79.8 (216)

(217)m=

87.93	87.69	87.15	85.89	83.49	79.8	79.8	79.8	79.8	85.98	87.42	88.02
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(217)

Fuel for water heating, kWh/month

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

(219)m=

222.78	196.91	208.08	189.28	190.81	178.4	171.34	188	187.67	196.06	203.88	217.2
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(219)

Total = $\text{Sum}(219a)_{1...12} =$ 2350.42 (219)

Annual totals

Space heating fuel used, main system 1 3770.73 kWh/year

Water heating fuel used 2350.42 kWh/year

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

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

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

Electricity for lighting 337.14 (232)

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

TER WorkSheet: New dwelling design stage

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
Space heating (main system 1)	(211) x		0.216	=	814.48 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	507.69 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1322.17 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	174.98 (268)
Total CO2, kg/year		sum of (265)...(271) =			1536.07 (272)
TER =					19.82 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 104 - Be Lean

Address : AV 104, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	52.5	(1a) x	2.6	(2a) =	136.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.5	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.5

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						=	0	x 10 =	0	(7a)
Number of passive vents						=	0	x 10 =	0	(7b)
Number of flueless gas fires						=	0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08	(21)

Infiltration rate modified for monthly wind speed

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

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

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

0.11	0.11	0.1	0.09	0.09	0.08	0.08	0.08	0.08	0.09	0.1	0.1
------	------	-----	------	------	------	------	------	------	------	-----	-----

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (24a)

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

(24b)m=

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

 (24b)

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

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

(24c)m=

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

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

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

 (24d)

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

(25)m=

0.23	0.22	0.22	0.21	0.21	0.2	0.2	0.2	0.2	0.21	0.21	0.22
------	------	------	------	------	-----	-----	-----	-----	------	------	------

 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			9.93	x1/[1/(1.4)+ 0.04] =	13.16		(27)
Windows Type 2			2.24	x1/[1/(1.4)+ 0.04] =	2.97		(27)
Windows Type 3			1.5	x1/[1/(1.4)+ 0.04] =	1.99		(27)
Windows Type 4			2.24	x1/[1/(1.4)+ 0.04] =	2.97		(27)
Windows Type 5			1.48	x1/[1/(1.4)+ 0.04] =	1.96		(27)
Walls	38.35	17.39	20.96	x 0.12 =	2.52		(29)
Total area of elements, m ²			38.35				(31)
Party wall			36.48	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 25.57 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.57 (36)

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

Total fabric heat loss (33) + (36) = 32.14 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	10.17	10.08	9.98	9.5	9.41	8.93	8.93	8.83	9.12	9.41	9.6	9.79

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

(39)m=	42.32	42.22	42.13	41.65	41.55	41.07	41.07	40.98	41.26	41.55	41.74	41.93
Average = Sum(39) _{1...12} /12=												
												41.62 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.81	0.8	0.8	0.79	0.79	0.78	0.78	0.78	0.79	0.79	0.8	0.8	
Average = Sum(40) _{1...12} / 12 =												0.79	(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 1.76 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 76.09 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	83.7	80.66	77.61	74.57	71.53	68.48	68.48	71.53	74.57	77.61	80.66	83.7	
Total = Sum(44) _{1...12} =												913.09	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.12	108.56	112.02	97.67	93.71	80.87	74.93	85.99	87.02	101.41	110.7	120.21	
Total = Sum(45) _{1...12} =												1197.2	(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=	18.62	16.28	16.8	14.65	14.06	12.13	11.24	12.9	13.05	15.21	16.6	18.03	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	179.4	158.49	167.3	151.16	148.99	134.36	130.21	141.27	140.51	156.69	164.19	175.48	(62)
--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	179.4	158.49	167.3	151.16	148.99	134.36	130.21	141.27	140.51	156.69	164.19	175.48	
Output from water heater (annual)_{1...12}												(64)	
												1848.04	

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

(65)m=	85.49	76.04	81.47	75.27	75.38	69.68	69.14	72.81	71.73	77.94	79.6	84.19	(65)
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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=	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	(66)

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

(67)m=	13.7	12.17	9.9	7.49	5.6	4.73	5.11	6.64	8.92	11.32	13.21	14.09	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	153.72	155.32	151.3	142.74	131.94	121.79	115	113.41	117.43	125.98	136.79	146.94	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	(71)
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Water heating gains (Table 5)

(72)m=	114.91	113.15	109.5	104.54	101.32	96.78	92.93	97.87	99.62	104.76	110.56	113.16	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	331.79	330.1	320.16	304.23	288.32	272.75	262.5	267.37	275.42	291.52	310.01	323.64	(73)
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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 _g Table 6b	FF Table 6c	Gains (W)
North	0.9x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">9.93</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">23.42</table> (74)
North	0.9x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">10.63</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">3.54</table> (74)
North	0.9x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">9.93</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">44.75</table> (74)
North	0.9x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">1.5</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">20.32</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">6.76</table> (74)
North	0.9x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.77</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">9.93</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">34.53</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.4</table>	x <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">0.8</table>	= <table border="1" style="display: inline-table; width: 40px; height: 20px; text-align: center;">76.04</table> (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.5	x	34.53	x	0.4	x	0.8	=	11.49	(74)
North	0.9x	0.77	x	9.93	x	55.46	x	0.4	x	0.8	=	122.14	(74)
North	0.9x	0.77	x	1.5	x	55.46	x	0.4	x	0.8	=	18.45	(74)
North	0.9x	0.77	x	9.93	x	74.72	x	0.4	x	0.8	=	164.53	(74)
North	0.9x	0.77	x	1.5	x	74.72	x	0.4	x	0.8	=	24.85	(74)
North	0.9x	0.77	x	9.93	x	79.99	x	0.4	x	0.8	=	176.13	(74)
North	0.9x	0.77	x	1.5	x	79.99	x	0.4	x	0.8	=	26.61	(74)
North	0.9x	0.77	x	9.93	x	74.68	x	0.4	x	0.8	=	164.44	(74)
North	0.9x	0.77	x	1.5	x	74.68	x	0.4	x	0.8	=	24.84	(74)
North	0.9x	0.77	x	9.93	x	59.25	x	0.4	x	0.8	=	130.46	(74)
North	0.9x	0.77	x	1.5	x	59.25	x	0.4	x	0.8	=	19.71	(74)
North	0.9x	0.77	x	9.93	x	41.52	x	0.4	x	0.8	=	91.42	(74)
North	0.9x	0.77	x	1.5	x	41.52	x	0.4	x	0.8	=	13.81	(74)
North	0.9x	0.77	x	9.93	x	24.19	x	0.4	x	0.8	=	53.27	(74)
North	0.9x	0.77	x	1.5	x	24.19	x	0.4	x	0.8	=	8.05	(74)
North	0.9x	0.77	x	9.93	x	13.12	x	0.4	x	0.8	=	28.89	(74)
North	0.9x	0.77	x	1.5	x	13.12	x	0.4	x	0.8	=	4.36	(74)
North	0.9x	0.77	x	9.93	x	8.86	x	0.4	x	0.8	=	19.52	(74)
North	0.9x	0.77	x	1.5	x	8.86	x	0.4	x	0.8	=	2.95	(74)
West	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(80)
West	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(80)
West	0.9x	0.77	x	1.48	x	19.64	x	0.4	x	0.8	=	6.45	(80)
West	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(80)
West	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(80)
West	0.9x	0.77	x	1.48	x	38.42	x	0.4	x	0.8	=	12.61	(80)
West	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(80)
West	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(80)
West	0.9x	0.77	x	1.48	x	63.27	x	0.4	x	0.8	=	20.77	(80)
West	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(80)
West	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(80)
West	0.9x	0.77	x	1.48	x	92.28	x	0.4	x	0.8	=	30.29	(80)
West	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(80)
West	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(80)
West	0.9x	0.77	x	1.48	x	113.09	x	0.4	x	0.8	=	37.12	(80)
West	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(80)
West	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(80)
West	0.9x	0.77	x	1.48	x	115.77	x	0.4	x	0.8	=	38	(80)
West	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(80)
West	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(80)
West	0.9x	0.77	x	1.48	x	110.22	x	0.4	x	0.8	=	36.17	(80)
West	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(80)
West	0.9x	0.77	x	1.48	x	94.68	x	0.4	x	0.8	=	31.07	(80)
West	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(80)
West	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(80)
West	0.9x	0.77	x	1.48	x	73.59	x	0.4	x	0.8	=	24.15	(80)
West	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(80)
West	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(80)
West	0.9x	0.77	x	1.48	x	45.59	x	0.4	x	0.8	=	14.96	(80)
West	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(80)
West	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(80)
West	0.9x	0.77	x	1.48	x	24.49	x	0.4	x	0.8	=	8.04	(80)
West	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(80)
West	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(80)
West	0.9x	0.77	x	1.48	x	16.15	x	0.4	x	0.8	=	5.3	(80)

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

(83)m=	52.91	102.29	171.15	262.55	338.86	355.75	334.96	275.3	202.49	121.57	65.62	43.82	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	384.7	432.39	491.31	566.78	627.17	628.51	597.45	542.68	477.92	413.09	375.63	367.46	(84)
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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.82	0.61	0.42	0.3	0.35	0.59	0.89	0.98	0.99	(86)

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

(87)m=	20.38	20.51	20.72	20.92	20.99	21	21	21	20.99	20.88	20.6	20.35	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.25	20.25	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.26	20.25	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.93	0.78	0.56	0.37	0.25	0.29	0.53	0.86	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.43	19.62	19.91	20.18	20.25	20.27	20.27	20.27	20.26	20.13	19.75	19.39	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.9	20.07	20.31	20.55	20.62	20.63	20.63	20.63	20.63	20.5	20.17	19.87	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.9	20.07	20.31	20.55	20.62	20.63	20.63	20.63	20.63	20.5	20.17	19.87	(93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.98	0.93	0.8	0.58	0.39	0.28	0.32	0.56	0.87	0.97	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	380.44	422	458.06	450.83	366.43	247.55	165.65	173.46	267.03	359.77	365.94	364.31	(95)
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Monthly average external temperature from Table 8

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

(97)m=	660.24	640.3	581.94	485.06	370.63	247.79	165.67	173.51	269.32	411.51	545.54	657.12	(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=	208.17	146.69	92.16	24.64	3.12	0	0	0	0	38.49	129.32	217.85	
--------	--------	--------	-------	-------	------	---	---	---	---	-------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 860.46 (98)

Space heating requirement in kWh/m²/year

	16.39	(99)
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9b. Energy requirements – Community heating scheme

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

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

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

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

Fraction of heat from Community boilers 1 (303a)

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

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

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Space heating

Annual space heating requirement 860.46 kWh/year

Space heat from Community boilers (98) x (304a) x (305) x (306) = 946.51 (307a)

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

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

Water heating

Annual water heating requirement 1848.04 kWh/year

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2032.85 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 29.79 (313)

Cooling System Energy Efficiency Ratio 0 (314)

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

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside 104.08 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 104.08 (331)

Energy for lighting (calculated in Appendix L) 242.03 (332)

12b. CO2 Emissions – Community heating scheme

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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DER WorkSheet: New dwelling design stage

CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel	95			(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	677.41	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	15.46	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	692.87	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			692.87	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	54.02	(378)
CO2 associated with electricity for lighting	(332)) x	0.52	=	125.61	(379)
Total CO2, kg/year	sum of (376)...(382) =			872.5	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.62	(384)
EI rating (section 14)				88.01	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 104 - Be Lean

Address : AV 104, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	52.5	(1a) x	2.6	(2a) =	136.5
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.5	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	136.5

2. Ventilation rate:

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0
Number of open flues	0	+	0	+	0	=	0	x 20 =	0
Number of intermittent fans							2	x 10 =	20
Number of passive vents							0	x 10 =	0
Number of flueless gas fires							0	x 40 =	0

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15		(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			0	[(9)-1]x0.1 =	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0		(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0		(12)
If no draught lobby, enter 0.05, else enter 0			0		(13)
Percentage of windows and doors draught stripped			0		(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0		(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0		(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5		(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4		(18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>					
Number of sides sheltered			2		(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85		(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.34		(21)

Infiltration rate modified for monthly wind speed

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

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

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

0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4
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Calculate effective air change rate for the applicable case

If mechanical ventilation: (23a)

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

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

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

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(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
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(24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
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(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=

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
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(24d)

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

(25)m=

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
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(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			<input type="text" value="7.49"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="9.93"/>		(27)
Windows Type 2			<input type="text" value="1.69"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.24"/>		(27)
Windows Type 3			<input type="text" value="1.13"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.5"/>		(27)
Windows Type 4			<input type="text" value="1.69"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.24"/>		(27)
Windows Type 5			<input type="text" value="1.12"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.48"/>		(27)
Walls	<input type="text" value="38.35"/>	<input type="text" value="13.12"/>	<input type="text" value="25.23"/>	x <input type="text" value="0.18"/>	$=$ <input type="text" value="4.54"/>		(29)
Total area of elements, m ²			<input type="text" value="38.35"/>				(31)
Party wall			<input type="text" value="36.48"/>	x <input type="text" value="0"/>	$=$ <input type="text" value="0"/>		(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium (35)

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

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	26.68	26.52	26.36	25.62	25.48	24.83	24.83	24.71	25.08	25.48	25.76	26.05

(38)

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

(39)m=	52.99	52.83	52.67	51.93	51.79	51.14	51.14	51.02	51.39	51.79	52.07	52.36
	Average = Sum(39) _{1...12} /12=											
	<input type="text" value="51.92"/> (39)											

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.01	1.01	1	0.99	0.99	0.97	0.97	0.97	0.98	0.99	0.99	1	
Average = Sum(40) _{1...12} / 12 =												0.99	(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 1.76 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 76.09 (43)
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	83.7	80.66	77.61	74.57	71.53	68.48	68.48	71.53	74.57	77.61	80.66	83.7	
Total = Sum(44) _{1...12} =												913.09	(44)

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

(45)m=	124.12	108.56	112.02	97.67	93.71	80.87	74.93	85.99	87.02	101.41	110.7	120.21	
Total = Sum(45) _{1...12} =												1197.2	(45)

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

(46)m=	18.62	16.28	16.8	14.65	14.06	12.13	11.24	12.9	13.05	15.21	16.6	18.03	(46)
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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)

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

(57)m=	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)
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Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m
 (modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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TER WorkSheet: New dwelling design stage

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.72	150.65	158.62	142.76	140.31	125.96	121.53	132.58	132.11	148	155.79	166.8	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	170.72	150.65	158.62	142.76	140.31	125.96	121.53	132.58	132.11	148	155.79	166.8	
Output from water heater (annual) _{1...12}												(64)	
												1745.82	

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

(65)m=	78.55	69.76	74.52	68.55	68.44	62.96	62.19	65.87	65.01	70.99	72.88	77.25	(65)
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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=	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	88.19	(66)

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

(67)m=	13.7	12.17	9.9	7.49	5.6	4.73	5.11	6.64	8.92	11.32	13.21	14.09	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	153.72	155.32	151.3	142.74	131.94	121.79	115	113.41	117.43	125.98	136.79	146.94	(68)
--------	--------	--------	-------	--------	--------	--------	-----	--------	--------	--------	--------	--------	------

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

(69)m=	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	31.82	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	-70.55	(71)
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Water heating gains (Table 5)

(72)m=	105.57	103.82	100.17	95.2	91.98	87.45	83.59	88.53	90.29	95.42	101.22	103.82	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	325.46	323.76	313.82	297.9	281.98	266.42	256.16	261.04	269.09	285.18	303.68	317.31	(73)
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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	x	Area m ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	7.49	x	10.63	x	0.63	x	0.7	=	24.34	(74)
North	0.9x		0.77	x	1.13	x	10.63	x	0.63	x	0.7	=	3.67	(74)
North	0.9x		0.77	x	7.49	x	20.32	x	0.63	x	0.7	=	46.52	(74)
North	0.9x		0.77	x	1.13	x	20.32	x	0.63	x	0.7	=	7.02	(74)
North	0.9x		0.77	x	7.49	x	34.53	x	0.63	x	0.7	=	79.04	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.13	x	34.53	x	0.63	x	0.7	=	11.92	(74)
North	0.9x	0.77	x	7.49	x	55.46	x	0.63	x	0.7	=	126.96	(74)
North	0.9x	0.77	x	1.13	x	55.46	x	0.63	x	0.7	=	19.15	(74)
North	0.9x	0.77	x	7.49	x	74.72	x	0.63	x	0.7	=	171.03	(74)
North	0.9x	0.77	x	1.13	x	74.72	x	0.63	x	0.7	=	25.8	(74)
North	0.9x	0.77	x	7.49	x	79.99	x	0.63	x	0.7	=	183.09	(74)
North	0.9x	0.77	x	1.13	x	79.99	x	0.63	x	0.7	=	27.62	(74)
North	0.9x	0.77	x	7.49	x	74.68	x	0.63	x	0.7	=	170.94	(74)
North	0.9x	0.77	x	1.13	x	74.68	x	0.63	x	0.7	=	25.79	(74)
North	0.9x	0.77	x	7.49	x	59.25	x	0.63	x	0.7	=	135.62	(74)
North	0.9x	0.77	x	1.13	x	59.25	x	0.63	x	0.7	=	20.46	(74)
North	0.9x	0.77	x	7.49	x	41.52	x	0.63	x	0.7	=	95.03	(74)
North	0.9x	0.77	x	1.13	x	41.52	x	0.63	x	0.7	=	14.34	(74)
North	0.9x	0.77	x	7.49	x	24.19	x	0.63	x	0.7	=	55.37	(74)
North	0.9x	0.77	x	1.13	x	24.19	x	0.63	x	0.7	=	8.35	(74)
North	0.9x	0.77	x	7.49	x	13.12	x	0.63	x	0.7	=	30.03	(74)
North	0.9x	0.77	x	1.13	x	13.12	x	0.63	x	0.7	=	4.53	(74)
North	0.9x	0.77	x	7.49	x	8.86	x	0.63	x	0.7	=	20.29	(74)
North	0.9x	0.77	x	1.13	x	8.86	x	0.63	x	0.7	=	3.06	(74)
West	0.9x	0.77	x	1.69	x	19.64	x	0.63	x	0.7	=	10.14	(80)
West	0.9x	0.77	x	1.69	x	19.64	x	0.63	x	0.7	=	10.14	(80)
West	0.9x	0.77	x	1.12	x	19.64	x	0.63	x	0.7	=	6.72	(80)
West	0.9x	0.77	x	1.69	x	38.42	x	0.63	x	0.7	=	19.84	(80)
West	0.9x	0.77	x	1.69	x	38.42	x	0.63	x	0.7	=	19.84	(80)
West	0.9x	0.77	x	1.12	x	38.42	x	0.63	x	0.7	=	13.15	(80)
West	0.9x	0.77	x	1.69	x	63.27	x	0.63	x	0.7	=	32.68	(80)
West	0.9x	0.77	x	1.69	x	63.27	x	0.63	x	0.7	=	32.68	(80)
West	0.9x	0.77	x	1.12	x	63.27	x	0.63	x	0.7	=	21.66	(80)
West	0.9x	0.77	x	1.69	x	92.28	x	0.63	x	0.7	=	47.66	(80)
West	0.9x	0.77	x	1.69	x	92.28	x	0.63	x	0.7	=	47.66	(80)
West	0.9x	0.77	x	1.12	x	92.28	x	0.63	x	0.7	=	31.59	(80)
West	0.9x	0.77	x	1.69	x	113.09	x	0.63	x	0.7	=	58.41	(80)
West	0.9x	0.77	x	1.69	x	113.09	x	0.63	x	0.7	=	58.41	(80)
West	0.9x	0.77	x	1.12	x	113.09	x	0.63	x	0.7	=	38.71	(80)
West	0.9x	0.77	x	1.69	x	115.77	x	0.63	x	0.7	=	59.79	(80)
West	0.9x	0.77	x	1.69	x	115.77	x	0.63	x	0.7	=	59.79	(80)
West	0.9x	0.77	x	1.12	x	115.77	x	0.63	x	0.7	=	39.63	(80)
West	0.9x	0.77	x	1.69	x	110.22	x	0.63	x	0.7	=	56.93	(80)
West	0.9x	0.77	x	1.69	x	110.22	x	0.63	x	0.7	=	56.93	(80)
West	0.9x	0.77	x	1.12	x	110.22	x	0.63	x	0.7	=	37.73	(80)
West	0.9x	0.77	x	1.69	x	94.68	x	0.63	x	0.7	=	48.9	(80)

TER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	1.69	x	94.68	x	0.63	x	0.7	=	48.9	(80)
West	0.9x	0.77	x	1.12	x	94.68	x	0.63	x	0.7	=	32.41	(80)
West	0.9x	0.77	x	1.69	x	73.59	x	0.63	x	0.7	=	38.01	(80)
West	0.9x	0.77	x	1.69	x	73.59	x	0.63	x	0.7	=	38.01	(80)
West	0.9x	0.77	x	1.12	x	73.59	x	0.63	x	0.7	=	25.19	(80)
West	0.9x	0.77	x	1.69	x	45.59	x	0.63	x	0.7	=	23.55	(80)
West	0.9x	0.77	x	1.69	x	45.59	x	0.63	x	0.7	=	23.55	(80)
West	0.9x	0.77	x	1.12	x	45.59	x	0.63	x	0.7	=	15.6	(80)
West	0.9x	0.77	x	1.69	x	24.49	x	0.63	x	0.7	=	12.65	(80)
West	0.9x	0.77	x	1.69	x	24.49	x	0.63	x	0.7	=	12.65	(80)
West	0.9x	0.77	x	1.12	x	24.49	x	0.63	x	0.7	=	8.38	(80)
West	0.9x	0.77	x	1.69	x	16.15	x	0.63	x	0.7	=	8.34	(80)
West	0.9x	0.77	x	1.69	x	16.15	x	0.63	x	0.7	=	8.34	(80)
West	0.9x	0.77	x	1.12	x	16.15	x	0.63	x	0.7	=	5.53	(80)

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

(83)m=	55.02	106.37	177.98	273.02	352.36	369.93	348.31	286.28	210.57	126.42	68.24	45.56	(83)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	380.48	430.13	491.8	570.92	634.34	636.35	604.47	547.32	479.66	411.61	371.91	362.87	(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=	0.99	0.99	0.97	0.89	0.71	0.51	0.37	0.43	0.7	0.94	0.99	1	(86)

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

(87)m=	20.07	20.22	20.47	20.78	20.95	20.99	21	21	20.97	20.72	20.34	20.05	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.08	20.09	20.09	20.11	20.11	20.11	20.1	20.09	20.09	20.09	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.86	0.66	0.44	0.3	0.35	0.62	0.91	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.84	19.06	19.42	19.85	20.05	20.1	20.1	20.11	20.08	19.78	19.25	18.82	(90)
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fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.46	19.64	19.95	20.31	20.5	20.55	20.55	20.55	20.52	20.25	19.8	19.43	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	------

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

(93)m=	19.46	19.64	19.95	20.31	20.5	20.55	20.55	20.55	20.52	20.25	19.8	19.43	(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	
(94)m=	0.99	0.98	0.96	0.87	0.68	0.47	0.33	0.39	0.66	0.92	0.98	0.99	(94)

TER WorkSheet: New dwelling design stage

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

(95)m=	377.38	423.06	470.5	494.19	433.66	301.81	201.8	211.25	316.78	378.54	365.54	360.53	(95)
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Monthly average external temperature from Table 8

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

(97)m=	803.09	778.63	708.22	592.47	455.54	304.09	202.05	211.79	329.9	499.77	661.14	797.49	(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=	316.73	238.94	176.86	70.76	16.28	0	0	0	0	90.2	212.83	325.09	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1447.7 (98)

Space heating requirement in kWh/m²/year

													(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
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Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
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Fraction of total heating from main system 1	(204) = (202) x [1 – (203)] =	1	(204)
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Efficiency of main space heating system 1		93.5	(206)
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Efficiency of secondary/supplementary heating system, %		0	(208)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

316.73	238.94	176.86	70.76	16.28	0	0	0	0	90.2	212.83	325.09
--------	--------	--------	-------	-------	---	---	---	---	------	--------	--------

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

338.75	255.55	189.16	75.68	17.41	0	0	0	0	96.47	227.63	347.69
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Total (kWh/year) =Sum(211)_{1...5,10...12} = 1548.34 (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)

170.72	150.65	158.62	142.76	140.31	125.96	121.53	132.58	132.11	148	155.79	166.8
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Efficiency of water heater		79.8	(216)
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(217)m=	86.44	86.04	85.1	83.05	80.79	79.8	79.8	79.8	79.8	83.54	85.65	86.56	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	197.5	175.09	186.38	171.88	173.66	157.84	152.29	166.14	165.55	177.16	181.9	192.69
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Total = Sum(219a)_{1...12} = 2098.1 (219)

Annual totals

Space heating fuel used, main system 1	kWh/year	kWh/year
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													1548.34
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Water heating fuel used		2098.1
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Electricity for pumps, fans and electric keep-hot

central heating pump:		30	(230c)
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TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		242.03	(232)

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	=	334.44 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	453.19 (264)
Space and water heating	(261) + (262) + (263) + (264) =				787.63 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	125.61 (268)
Total CO2, kg/year		sum of (265)...(271) =			952.17 (272)
TER =					18.14 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 107 - Be Lean

Address : AV 107, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	74.8	(1a) x	2.6	(2a) =	194.48 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.8	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	194.48 (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							0	x 10 =		0 (7a)
Number of passive vents							0	x 10 =		0 (7b)
Number of flueless gas fires							0	x 40 =		0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.08 (21)
Infiltration rate modified for monthly wind speed			

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

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

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

0.1	0.1	0.09	0.09	0.08	0.07	0.07	0.07	0.08	0.08	0.09	0.09
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m=

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
------	------	------	-----	-----	------	------	------	-----	-----	-----	------

 (24a)

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

(24b)m=

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

 (24b)

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

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

(24c)m=

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

 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m=

0.22	0.21	0.21	0.2	0.2	0.19	0.19	0.19	0.2	0.2	0.2	0.21
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 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Windows Type 2			9.56	x1/[1/(1.4)+0.04] =	12.67		(27)
Windows Type 3			1.39	x1/[1/(1.4)+0.04] =	1.84		(27)
Windows Type 4			1.39	x1/[1/(1.4)+0.04] =	1.84		(27)
Windows Type 5			2.24	x1/[1/(1.4)+0.04] =	2.97		(27)
Floor			4.72	x	0.12 =	0.5664	(28)
Walls	34.19	16.82	17.37	x	0.12 =	2.08	(29)
Total area of elements, m ²			38.91				(31)
Party wall			62.82	x	0 =	0	(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 24.95 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.44 (36)

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

Total fabric heat loss (33) + (36) = 32.39 (37)

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
13.88	13.76	13.63	13.01	12.89	12.27	12.27	12.14	12.51	12.89	13.14	13.39

 (38)

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

(39)m=

46.27	46.15	46.02	45.4	45.28	44.66	44.66	44.53	44.91	45.28	45.53	45.78
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 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.62	0.62	0.62	0.61	0.61	0.6	0.6	0.6	0.6	0.61	0.61	0.61	
	Average = Sum(40) _{1...12} / 12 =											0.61	(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 2.36 (42)

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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.17 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	99.19	95.58	91.98	88.37	84.76	81.16	81.16	84.76	88.37	91.98	95.58	99.19	
(44)m=	Total = Sum(44) _{1...12} =											1082.09	(44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	147.1	128.65	132.76	115.74	111.06	95.83	88.8	101.9	103.12	120.18	131.18	142.46	
	Total = Sum(45) _{1...12} =											1418.79	(45)

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

(46)m= 22.06 19.3 19.91 17.36 16.66 14.38 13.32 15.29 15.47 18.03 19.68 21.37 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	202.38	178.58	188.04	169.24	166.33	149.33	144.08	157.18	156.61	175.45	184.68	197.73	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	202.38	178.58	188.04	169.24	166.33	149.33	144.08	157.18	156.61	175.45	184.68	197.73	
Output from water heater (annual) _{1...12}												(64)	
											2069.63		

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

(65)m=	93.13	82.72	88.36	81.28	81.15	74.66	73.75	78.1	77.08	84.18	86.41	91.59	(65)
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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=	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	(66)

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

(67)m=	18.56	16.49	13.41	10.15	7.59	6.41	6.92	9	12.08	15.33	17.9	19.08	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	208.23	210.39	204.95	193.36	178.72	164.97	155.78	153.62	159.07	170.66	185.29	199.04	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	(69)
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Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	(71)
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Water heating gains (Table 5)

(72)m=	125.18	123.09	118.77	112.89	109.07	103.69	99.12	104.98	107.06	113.15	120.02	123.1	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	410.32	408.33	395.48	374.75	353.73	333.42	320.18	325.95	336.55	357.49	381.56	399.58	(73)
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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	x	Area m ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	1.39	x	10.63	x	0.4	x	0.8	=	3.28	(74)
North	0.9x		0.77	x	1.39	x	20.32	x	0.4	x	0.8	=	6.26	(74)
North	0.9x		0.77	x	1.39	x	34.53	x	0.4	x	0.8	=	10.64	(74)
North	0.9x		0.77	x	1.39	x	55.46	x	0.4	x	0.8	=	17.1	(74)
North	0.9x		0.77	x	1.39	x	74.72	x	0.4	x	0.8	=	23.03	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.39	x	79.99	x	0.4	x	0.8	=	24.66	(74)
North	0.9x	0.77	x	1.39	x	74.68	x	0.4	x	0.8	=	23.02	(74)
North	0.9x	0.77	x	1.39	x	59.25	x	0.4	x	0.8	=	18.26	(74)
North	0.9x	0.77	x	1.39	x	41.52	x	0.4	x	0.8	=	12.8	(74)
North	0.9x	0.77	x	1.39	x	24.19	x	0.4	x	0.8	=	7.46	(74)
North	0.9x	0.77	x	1.39	x	13.12	x	0.4	x	0.8	=	4.04	(74)
North	0.9x	0.77	x	1.39	x	8.86	x	0.4	x	0.8	=	2.73	(74)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	9.56	x	19.64	x	0.4	x	0.8	=	41.64	(76)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	9.56	x	38.42	x	0.4	x	0.8	=	81.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	9.56	x	63.27	x	0.4	x	0.8	=	134.14	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	9.56	x	92.28	x	0.4	x	0.8	=	195.64	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	9.56	x	113.09	x	0.4	x	0.8	=	239.76	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	9.56	x	115.77	x	0.4	x	0.8	=	245.44	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	9.56	x	110.22	x	0.4	x	0.8	=	233.67	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	9.56	x	94.68	x	0.4	x	0.8	=	200.72	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	9.56	x	73.59	x	0.4	x	0.8	=	156.01	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	9.56	x	45.59	x	0.4	x	0.8	=	96.65	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)
East	0.9x	0.77	x	9.56	x	24.49	x	0.4	x	0.8	=	51.92	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	0.77	x	9.56	x	16.15	x	0.4	x	0.8	=	34.24	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(76)
South	0.9x	0.77	x	1.39	x	46.75	x	0.4	x	0.8	=	14.41	(78)
South	0.9x	0.77	x	1.39	x	76.57	x	0.4	x	0.8	=	23.6	(78)
South	0.9x	0.77	x	1.39	x	97.53	x	0.4	x	0.8	=	30.06	(78)
South	0.9x	0.77	x	1.39	x	110.23	x	0.4	x	0.8	=	33.98	(78)
South	0.9x	0.77	x	1.39	x	114.87	x	0.4	x	0.8	=	35.41	(78)
South	0.9x	0.77	x	1.39	x	110.55	x	0.4	x	0.8	=	34.08	(78)
South	0.9x	0.77	x	1.39	x	108.01	x	0.4	x	0.8	=	33.29	(78)
South	0.9x	0.77	x	1.39	x	104.89	x	0.4	x	0.8	=	32.33	(78)
South	0.9x	0.77	x	1.39	x	101.89	x	0.4	x	0.8	=	31.41	(78)
South	0.9x	0.77	x	1.39	x	82.59	x	0.4	x	0.8	=	25.46	(78)
South	0.9x	0.77	x	1.39	x	55.42	x	0.4	x	0.8	=	17.08	(78)
South	0.9x	0.77	x	1.39	x	40.4	x	0.4	x	0.8	=	12.45	(78)

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

(83)m=	78.84	149.49	237.71	338.39	410.55	419.18	399.48	345.37	273.32	174.86	97.37	65.47	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	489.16	557.81	633.19	713.14	764.29	752.61	719.66	671.32	609.88	532.35	478.93	465.05	(84)
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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.92	0.75	0.55	0.38	0.27	0.31	0.51	0.83	0.98	0.99	(86)

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

(87)m=	20.6	20.72	20.88	20.98	21	21	21	21	21	20.96	20.77	20.57	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.41	20.41	20.42	20.42	20.43	20.43	20.43	20.43	20.43	20.43	20.42	20.42	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.9	0.72	0.52	0.35	0.24	0.27	0.47	0.8	0.97	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.88	20.06	20.27	20.4	20.42	20.43	20.43	20.43	20.43	20.39	20.13	19.85	(90)
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fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	20.13	20.29	20.48	20.6	20.62	20.63	20.63	20.63	20.63	20.59	20.35	20.1	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.13	20.29	20.48	20.6	20.62	20.63	20.63	20.63	20.63	20.59	20.35	20.1	(93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.97	0.9	0.73	0.53	0.36	0.25	0.28	0.48	0.81	0.97	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	483.76	540.75	571.21	519.98	403.25	269.22	179.93	188.38	292.83	431.23	463.75	461.38	(95)
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Monthly average external temperature from Table 8

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

(97)m=	732.53	710.22	643.54	531.34	404.02	269.24	179.93	188.38	293.09	452.15	603.36	727.78	(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=	185.08	113.88	53.82	8.18	0.57	0	0	0	0	15.57	100.52	198.2	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 675.83 (98)

Space heating requirement in kWh/m²/year

	9.04 (99)
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9b. Energy requirements – Community heating scheme

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

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

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

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

Fraction of heat from Community boilers 1 (303a)

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

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

Distribution loss factor (Table 12c) for community heating system 1.1 (306)

Space heating

Annual space heating requirement 675.83 kWh/year

Space heat from Community boilers (98) x (304a) x (305) x (306) = 743.42 (307a)

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

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

Water heating

Annual water heating requirement 2069.63 kWh/year

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 2276.59 (310a)

Electricity used for heat distribution 0.01 x [(307a)...(307e) + (310a)...(310e)] = 30.2 (313)

Cooling System Energy Efficiency Ratio 0 (314)

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

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside 157.19 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 157.19 (331)

Energy for lighting (calculated in Appendix L) 327.85 (332)

12b. CO2 Emissions – Community heating scheme

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
--------------------	-------------------------------	--------------------------

DER WorkSheet: New dwelling design stage

CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel	95			(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	686.66	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	15.67	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	702.33	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			702.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	81.58	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	170.15	(379)
Total CO2, kg/year	sum of (376)...(382) =			954.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			12.75	(384)
EI rating (section 14)				89.33	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 107 - Be Lean

Address : AV 107, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	74.8	(1a) x	2.6	(2a) =	194.48 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.8	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	194.48 (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) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4 (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			3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.31 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation: (23a)

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

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

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

(24a)m=

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

(24a)

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

(24b)m=

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

(24b)

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

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

(24c)m=

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

(24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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(24d)

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

(25)m=

0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57
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(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Windows Type 2			<input type="text" value="9.56"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="12.67"/>		(27)
Windows Type 3			<input type="text" value="1.39"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.84"/>		(27)
Windows Type 4			<input type="text" value="1.39"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="1.84"/>		(27)
Windows Type 5			<input type="text" value="2.24"/>	$x1/[1/(1.4)+0.04] =$	<input type="text" value="2.97"/>		(27)
Floor			<input type="text" value="4.72"/>	x <input type="text" value="0.13"/>	$=$ <input type="text" value="0.6136"/>	<input type="text"/>	(28)
Walls	<input type="text" value="34.19"/>	<input type="text" value="16.82"/>	<input type="text" value="17.37"/>	x <input type="text" value="0.18"/>	$=$ <input type="text" value="3.13"/>	<input type="text"/>	(29)
Total area of elements, m ²			<input type="text" value="38.91"/>				(31)
Party wall			<input type="text" value="62.82"/>	x <input type="text" value="0"/>	$=$ <input type="text" value="0"/>	<input type="text"/>	(32)

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

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

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

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium (35)

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

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

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

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

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
37.21	37.01	36.82	35.9	35.73	34.93	34.93	34.78	35.24	35.73	36.08	36.44

(38)

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

(39)m=

68.71	68.51	68.32	67.4	67.23	66.43	66.43	66.28	66.74	67.23	67.58	67.94
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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.92	0.92	0.91	0.9	0.9	0.89	0.89	0.89	0.89	0.9	0.9	0.91	
Average = Sum(40) _{1...12} / 12 =												0.9	(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 2.36 (42)

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

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.17 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	99.19	95.58	91.98	88.37	84.76	81.16	81.16	84.76	88.37	91.98	95.58	99.19	(44)
Total = Sum(44) _{1...12} =												1082.09	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	147.1	128.65	132.76	115.74	111.06	95.83	88.8	101.9	103.12	120.18	131.18	142.46	(45)
Total = Sum(45) _{1...12} =												1418.79	

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

(46)m= 22.06 19.3 19.91 17.36 16.66 14.38 13.32 15.29 15.47 18.03 19.68 21.37 (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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(62)m=	193.69	170.74	179.35	160.83	157.65	140.93	135.4	148.5	148.21	166.77	176.28	189.05	(62)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	------

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	193.69	170.74	179.35	160.83	157.65	140.93	135.4	148.5	148.21	166.77	176.28	189.05	
Output from water heater (annual) _{1...12}												(64)	
												1967.41	

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

(65)m=	86.19	76.45	81.42	74.56	74.2	67.94	66.8	71.16	70.36	77.24	79.69	84.64	(65)
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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=	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	117.84	(66)

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

(67)m=	18.56	16.49	13.41	10.15	7.59	6.41	6.92	9	12.08	15.33	17.9	19.08	(67)
--------	-------	-------	-------	-------	------	------	------	---	-------	-------	------	-------	------

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

(68)m=	208.23	210.39	204.95	193.36	178.72	164.97	155.78	153.62	159.07	170.66	185.29	199.04	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	34.78	(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=	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	-94.27	(71)
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Water heating gains (Table 5)

(72)m=	115.84	113.76	109.43	103.55	99.73	94.36	89.79	95.64	97.72	103.81	110.68	113.77	(72)
--------	--------	--------	--------	--------	-------	-------	-------	-------	-------	--------	--------	--------	------

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

(73)m=	403.99	401.99	389.14	368.41	347.4	327.09	313.84	319.61	330.22	351.15	375.22	393.24	(73)
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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	x	Area m ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	1.39	x	10.63	x	0.63	x	0.7	=	4.52	(74)
North	0.9x		0.77	x	1.39	x	20.32	x	0.63	x	0.7	=	8.63	(74)
North	0.9x		0.77	x	1.39	x	34.53	x	0.63	x	0.7	=	14.67	(74)
North	0.9x		0.77	x	1.39	x	55.46	x	0.63	x	0.7	=	23.56	(74)
North	0.9x		0.77	x	1.39	x	74.72	x	0.63	x	0.7	=	31.74	(74)

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North	0.9x	0.77	x	1.39	x	79.99	x	0.63	x	0.7	=	33.98	(74)
North	0.9x	0.77	x	1.39	x	74.68	x	0.63	x	0.7	=	31.72	(74)
North	0.9x	0.77	x	1.39	x	59.25	x	0.63	x	0.7	=	25.17	(74)
North	0.9x	0.77	x	1.39	x	41.52	x	0.63	x	0.7	=	17.64	(74)
North	0.9x	0.77	x	1.39	x	24.19	x	0.63	x	0.7	=	10.28	(74)
North	0.9x	0.77	x	1.39	x	13.12	x	0.63	x	0.7	=	5.57	(74)
North	0.9x	0.77	x	1.39	x	8.86	x	0.63	x	0.7	=	3.77	(74)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	9.56	x	19.64	x	0.63	x	0.7	=	57.38	(76)
East	0.9x	0.77	x	2.24	x	19.64	x	0.63	x	0.7	=	13.45	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	9.56	x	38.42	x	0.63	x	0.7	=	112.25	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.63	x	0.7	=	26.3	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	9.56	x	63.27	x	0.63	x	0.7	=	184.86	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.63	x	0.7	=	43.32	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	9.56	x	92.28	x	0.63	x	0.7	=	269.61	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.63	x	0.7	=	63.17	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	9.56	x	113.09	x	0.63	x	0.7	=	330.42	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.63	x	0.7	=	77.42	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	9.56	x	115.77	x	0.63	x	0.7	=	338.24	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.63	x	0.7	=	79.25	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	9.56	x	110.22	x	0.63	x	0.7	=	322.02	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.63	x	0.7	=	75.45	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	9.56	x	94.68	x	0.63	x	0.7	=	276.61	(76)
East	0.9x	0.77	x	2.24	x	94.68	x	0.63	x	0.7	=	64.81	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	9.56	x	73.59	x	0.63	x	0.7	=	215	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.63	x	0.7	=	50.38	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	9.56	x	45.59	x	0.63	x	0.7	=	133.2	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.63	x	0.7	=	31.21	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	9.56	x	24.49	x	0.63	x	0.7	=	71.55	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.63	x	0.7	=	16.76	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)

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East	0.9x	0.77	x	9.56	x	16.15	x	0.63	x	0.7	=	47.19	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.63	x	0.7	=	11.06	(76)
South	0.9x	0.77	x	1.39	x	46.75	x	0.63	x	0.7	=	19.86	(78)
South	0.9x	0.77	x	1.39	x	76.57	x	0.63	x	0.7	=	32.53	(78)
South	0.9x	0.77	x	1.39	x	97.53	x	0.63	x	0.7	=	41.43	(78)
South	0.9x	0.77	x	1.39	x	110.23	x	0.63	x	0.7	=	46.83	(78)
South	0.9x	0.77	x	1.39	x	114.87	x	0.63	x	0.7	=	48.8	(78)
South	0.9x	0.77	x	1.39	x	110.55	x	0.63	x	0.7	=	46.96	(78)
South	0.9x	0.77	x	1.39	x	108.01	x	0.63	x	0.7	=	45.88	(78)
South	0.9x	0.77	x	1.39	x	104.89	x	0.63	x	0.7	=	44.56	(78)
South	0.9x	0.77	x	1.39	x	101.89	x	0.63	x	0.7	=	43.28	(78)
South	0.9x	0.77	x	1.39	x	82.59	x	0.63	x	0.7	=	35.08	(78)
South	0.9x	0.77	x	1.39	x	55.42	x	0.63	x	0.7	=	23.54	(78)
South	0.9x	0.77	x	1.39	x	40.4	x	0.63	x	0.7	=	17.16	(78)

Solar gains in watts, calculated for each month

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

(83)m=	108.65	206.01	327.59	466.35	565.8	577.69	550.53	475.96	376.67	240.97	134.19	90.23	(83)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	512.64	608	716.73	834.76	913.19	904.77	864.38	795.58	706.89	592.13	509.41	483.47	(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=	1	0.99	0.96	0.85	0.66	0.47	0.34	0.38	0.63	0.92	0.99	1	(86)

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

(87)m=	20.16	20.34	20.6	20.86	20.97	21	21	21	20.98	20.8	20.43	20.13	(87)
--------	-------	-------	------	-------	-------	----	----	----	-------	------	-------	-------	------

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

(88)m=	20.15	20.15	20.16	20.17	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.94	0.82	0.61	0.41	0.27	0.31	0.57	0.89	0.99	1	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	19.04	19.3	19.66	20.02	20.15	20.18	20.18	20.18	20.16	19.95	19.43	19	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	------

fLA = Living area ÷ (4) =

0.35 (91)

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

(92)m=	19.43	19.66	19.99	20.31	20.43	20.46	20.46	20.46	20.45	20.24	19.78	19.39	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.43	19.66	19.99	20.31	20.43	20.46	20.46	20.46	20.45	20.24	19.78	19.39	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.99	0.98	0.94	0.82	0.63	0.43	0.3	0.34	0.59	0.9	0.98	0.99	(94)

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

(95)m=	508.98	596.54	675.01	686.38	572.58	388.14	256.48	269.11	416.31	530.51	500.64	480.94	(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=	1039.52	1011.06	921.48	768.94	587.04	389.32	256.57	269.32	423.63	648.24	856.6	1032.21	(97)
--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	-------	---------	------

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

(98)m=	394.73	278.56	183.37	59.45	10.75	0	0	0	0	87.59	256.29	410.14	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1680.89 (98)

Space heating requirement in kWh/m²/year

													(99)
													22.47

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

Space heating:

Fraction of space heat from secondary/supplementary system

													(201)
													0

Fraction of space heat from main system(s)

(202) = 1 – (201) =

													(202)
													1

Fraction of total heating from main system 1

(204) = (202) x [1 – (203)] =

													(204)
													1

Efficiency of main space heating system 1

													(206)
													93.5

Efficiency of secondary/supplementary heating system, %

													(208)
													0

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

Space heating requirement (calculated above)

394.73	278.56	183.37	59.45	10.75	0	0	0	0	87.59	256.29	410.14
--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------

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

422.17	297.93	196.12	63.58	11.5	0	0	0	0	93.68	274.11	438.66
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 1797.74 (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	
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Total (kWh/year) =Sum(215)_{1...5,10...12} = 0 (215)

Water heating

Output from water heater (calculated above)

193.69	170.74	179.35	160.83	157.65	140.93	135.4	148.5	148.21	166.77	176.28	189.05
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Efficiency of water heater

													(216)
													79.8

(217)m=	86.67	86.11	84.87	82.43	80.41	79.8	79.8	79.8	79.8	83.19	85.81	86.83	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	223.47	198.27	211.32	195.12	196.07	176.6	169.67	186.09	185.73	200.48	205.42	217.73
---------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2365.98 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

													kWh/year
													1797.74

Water heating fuel used

													2365.98
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Electricity for pumps, fans and electric keep-hot

central heating pump:

													(230c)
													30

TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		327.8	(232)

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	=	388.31 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	511.05 (264)
Space and water heating	(261) + (262) + (263) + (264) =				899.36 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	170.13 (268)
Total CO2, kg/year		sum of (265)...(271) =			1108.42 (272)
TER =					14.82 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 206 - Be Lean

Address : AV 206, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	77.6	(1a) x	2.6	(2a) =	201.76 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.6	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201.76 (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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			2	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.1	(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			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.09	(21)

Infiltration rate modified for monthly wind speed

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

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

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

0.12	0.12	0.11	0.1	0.1	0.09	0.09	0.09	0.09	0.1	0.1	0.11
------	------	------	-----	-----	------	------	------	------	-----	-----	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

76.5 (23c)

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

(24a)m=

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (24a)

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

(24b)m=

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

 (24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (24c)

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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (24d)

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

(25)m=

0.24	0.23	0.23	0.22	0.22	0.21	0.21	0.2	0.21	0.22	0.22	0.23
------	------	------	------	------	------	------	-----	------	------	------	------

 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			6.87	$x1/[1/(1.4)+0.04] =$	9.11		(27)
Windows Type 2			2.71	$x1/[1/(1.4)+0.04] =$	3.59		(27)
Windows Type 3			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 4			4.1	$x1/[1/(1.4)+0.04] =$	5.44		(27)
Windows Type 5			2.24	$x1/[1/(1.4)+0.04] =$	2.97		(27)
Windows Type 6			6.18	$x1/[1/(1.4)+0.04] =$	8.19		(27)
Walls	56.73	24.34	32.39	x 0.12 =	3.89		(29)
Total area of elements, m ²			56.73				(31)
Party wall			34.53	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 36.16 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.73 (36)

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

Total fabric heat loss (33) + (36) = 43.89 (37)

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
15.68	15.52	15.37	14.6	14.44	13.67	13.67	13.52	13.98	14.44	14.75	15.06

 (38)

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

(39)m=

59.56	59.41	59.26	58.49	58.33	57.56	57.56	57.41	57.87	58.33	58.64	58.95
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DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.76	
Average = Sum(40) _{1...12} / 12 =												0.75	(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 2.42 (42)

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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.57 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	100.73	97.07	93.41	89.74	86.08	82.42	82.42	86.08	89.74	93.41	97.07	100.73	(44)
Total = Sum(44) _{1...12} =												1098.89	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	149.38	130.65	134.82	117.54	112.78	97.32	90.18	103.49	104.72	122.04	133.22	144.67	(45)
Total = Sum(45) _{1...12} =												1440.81	

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

(46)m= 22.41 19.6 20.22 17.63 16.92 14.6 13.53 15.52 15.71 18.31 19.98 21.7 (46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	6.18	x	34.53	x	0.4	x	0.8	=	47.32	(74)
North	0.9x	0.77	x	6.87	x	55.46	x	0.4	x	0.8	=	84.5	(74)
North	0.9x	0.77	x	6.18	x	55.46	x	0.4	x	0.8	=	76.01	(74)
North	0.9x	0.77	x	6.87	x	74.72	x	0.4	x	0.8	=	113.83	(74)
North	0.9x	0.77	x	6.18	x	74.72	x	0.4	x	0.8	=	102.4	(74)
North	0.9x	0.77	x	6.87	x	79.99	x	0.4	x	0.8	=	121.86	(74)
North	0.9x	0.77	x	6.18	x	79.99	x	0.4	x	0.8	=	109.62	(74)
North	0.9x	0.77	x	6.87	x	74.68	x	0.4	x	0.8	=	113.77	(74)
North	0.9x	0.77	x	6.18	x	74.68	x	0.4	x	0.8	=	102.34	(74)
North	0.9x	0.77	x	6.87	x	59.25	x	0.4	x	0.8	=	90.26	(74)
North	0.9x	0.77	x	6.18	x	59.25	x	0.4	x	0.8	=	81.2	(74)
North	0.9x	0.77	x	6.87	x	41.52	x	0.4	x	0.8	=	63.25	(74)
North	0.9x	0.77	x	6.18	x	41.52	x	0.4	x	0.8	=	56.9	(74)
North	0.9x	0.77	x	6.87	x	24.19	x	0.4	x	0.8	=	36.85	(74)
North	0.9x	0.77	x	6.18	x	24.19	x	0.4	x	0.8	=	33.15	(74)
North	0.9x	0.77	x	6.87	x	13.12	x	0.4	x	0.8	=	19.98	(74)
North	0.9x	0.77	x	6.18	x	13.12	x	0.4	x	0.8	=	17.98	(74)
North	0.9x	0.77	x	6.87	x	8.86	x	0.4	x	0.8	=	13.51	(74)
North	0.9x	0.77	x	6.18	x	8.86	x	0.4	x	0.8	=	12.15	(74)
East	0.9x	0.77	x	2.71	x	19.64	x	0.4	x	0.8	=	11.8	(76)
East	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(76)
East	0.9x	0.77	x	4.1	x	19.64	x	0.4	x	0.8	=	17.86	(76)
East	0.9x	0.77	x	2.71	x	38.42	x	0.4	x	0.8	=	23.09	(76)
East	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(76)
East	0.9x	0.77	x	4.1	x	38.42	x	0.4	x	0.8	=	34.93	(76)
East	0.9x	0.77	x	2.71	x	63.27	x	0.4	x	0.8	=	38.03	(76)
East	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(76)
East	0.9x	0.77	x	4.1	x	63.27	x	0.4	x	0.8	=	57.53	(76)
East	0.9x	0.77	x	2.71	x	92.28	x	0.4	x	0.8	=	55.46	(76)
East	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(76)
East	0.9x	0.77	x	4.1	x	92.28	x	0.4	x	0.8	=	83.9	(76)
East	0.9x	0.77	x	2.71	x	113.09	x	0.4	x	0.8	=	67.97	(76)
East	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(76)
East	0.9x	0.77	x	4.1	x	113.09	x	0.4	x	0.8	=	102.83	(76)
East	0.9x	0.77	x	2.71	x	115.77	x	0.4	x	0.8	=	69.57	(76)
East	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(76)
East	0.9x	0.77	x	4.1	x	115.77	x	0.4	x	0.8	=	105.26	(76)
East	0.9x	0.77	x	2.71	x	110.22	x	0.4	x	0.8	=	66.24	(76)
East	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(76)
East	0.9x	0.77	x	4.1	x	110.22	x	0.4	x	0.8	=	100.21	(76)
East	0.9x	0.77	x	2.71	x	94.68	x	0.4	x	0.8	=	56.9	(76)

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East	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(76)
East	0.9x	0.77	x	4.1	x	94.68	x	0.4	x	0.8	=	86.08	(76)
East	0.9x	0.77	x	2.71	x	73.59	x	0.4	x	0.8	=	44.22	(76)
East	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(76)
East	0.9x	0.77	x	4.1	x	73.59	x	0.4	x	0.8	=	66.91	(76)
East	0.9x	0.77	x	2.71	x	45.59	x	0.4	x	0.8	=	27.4	(76)
East	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(76)
East	0.9x	0.77	x	4.1	x	45.59	x	0.4	x	0.8	=	41.45	(76)
East	0.9x	0.77	x	2.71	x	24.49	x	0.4	x	0.8	=	14.72	(76)
East	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(76)
East	0.9x	0.77	x	4.1	x	24.49	x	0.4	x	0.8	=	22.27	(76)
East	0.9x	0.77	x	2.71	x	16.15	x	0.4	x	0.8	=	9.71	(76)
East	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(76)
East	0.9x	0.77	x	4.1	x	16.15	x	0.4	x	0.8	=	14.68	(76)
West	0.9x	0.77	x	2.24	x	19.64	x	0.4	x	0.8	=	9.76	(80)
West	0.9x	0.77	x	2.24	x	38.42	x	0.4	x	0.8	=	19.09	(80)
West	0.9x	0.77	x	2.24	x	63.27	x	0.4	x	0.8	=	31.43	(80)
West	0.9x	0.77	x	2.24	x	92.28	x	0.4	x	0.8	=	45.84	(80)
West	0.9x	0.77	x	2.24	x	113.09	x	0.4	x	0.8	=	56.18	(80)
West	0.9x	0.77	x	2.24	x	115.77	x	0.4	x	0.8	=	57.51	(80)
West	0.9x	0.77	x	2.24	x	110.22	x	0.4	x	0.8	=	54.75	(80)
West	0.9x	0.77	x	2.24	x	94.68	x	0.4	x	0.8	=	47.03	(80)
West	0.9x	0.77	x	2.24	x	73.59	x	0.4	x	0.8	=	36.55	(80)
West	0.9x	0.77	x	2.24	x	45.59	x	0.4	x	0.8	=	22.65	(80)
West	0.9x	0.77	x	2.24	x	24.49	x	0.4	x	0.8	=	12.16	(80)
West	0.9x	0.77	x	2.24	x	16.15	x	0.4	x	0.8	=	8.02	(80)

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

(83)m=	79.95	155	258.34	391.55	499.37	521.33	492.06	408.49	304.39	184.14	99.27	66.09	(83)
--------	-------	-----	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	------

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

(84)m=	498.84	571.87	662.04	773.99	860.23	861.36	818.52	740.82	647.6	548.82	488.63	473.95	(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=	1	0.99	0.96	0.83	0.62	0.43	0.31	0.36	0.61	0.92	0.99	1	(86)

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

(87)m=	20.35	20.49	20.71	20.92	20.99	21	21	21	20.99	20.86	20.57	20.33	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.28	20.28	20.28	20.29	20.3	20.3	20.3	20.31	20.3	20.3	20.29	20.29	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.95	0.8	0.58	0.38	0.26	0.3	0.55	0.89	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.41	19.62	19.92	20.21	20.29	20.3	20.3	20.31	20.3	20.15	19.73	19.38	(90)
--------	-------	-------	-------	-------	-------	------	------	-------	------	-------	-------	-------	------

$$fLA = \text{Living area} \div (4) = \boxed{0.36} \quad (91)$$

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

(92)m=	19.75	19.93	20.21	20.47	20.54	20.56	20.56	20.56	20.55	20.41	20.04	19.72	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.75	19.93	20.21	20.47	20.54	20.56	20.56	20.56	20.55	20.41	20.04	19.72	(93)
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8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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=	0.99	0.98	0.95	0.81	0.59	0.4	0.28	0.32	0.57	0.89	0.98	1	(94)
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Useful gains, hmG_m , $W = (94)m \times (84)m$

(95)m=	495.74	562.73	626.29	627.56	510.41	342.61	227.76	238.66	370.24	491.14	480.85	471.8	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]]$

(97)m=	920.54	893.18	812.31	676.46	515.8	342.87	227.77	238.71	373.25	572.16	758.64	915.08	(97)
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Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	316.05	222.06	138.39	35.21	4.01	0	0	0	0	60.28	200.01	329.81	
$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$												$\boxed{1305.83}$	(98)

Space heating requirement in $kWh/m^2/year$

$$\boxed{16.83} \quad (99)$$

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none $\boxed{0}$ (301)

Fraction of space heat from community system 1 – (301) = $\boxed{1}$ (302)

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

Fraction of heat from Community boilers $\boxed{1}$ (303a)

Fraction of total space heat from Community boilers $(302) \times (303a) = \boxed{1}$ (304a)

Factor for control and charging method (Table 4c(3)) for community heating system $\boxed{1}$ (305)

Distribution loss factor (Table 12c) for community heating system $\boxed{1.1}$ (306)

Space heating

Annual space heating requirement $\boxed{1305.83}$

Space heat from Community boilers $(98) \times (304a) \times (305) \times (306) = \boxed{1436.41}$ (307a)

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

Space heating requirement from secondary/supplementary system $(98) \times (301) \times 100 \div (308) = \boxed{0}$ (309)

Water heating

Annual water heating requirement $\boxed{2091.65}$

If DHW from community scheme:

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Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2300.82	(310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	37.37	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		163.07	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	163.07	(331)
Energy for lighting (calculated in Appendix L)		337.48	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	849.73	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	19.4	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)		=	869.12	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			869.12	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	=	84.63	(378)
CO2 associated with electricity for lighting	(332)) x	0.52	=	175.15	(379)
Total CO2, kg/year	sum of (376)...(382) =			1128.91	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.55	(384)
EI rating (section 14)				87.66	(385)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	John Simpson	Stroma Number:	STRO006273
Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.5.8

Property Address: AV 206 - Be Lean

Address : AV 206, Aspen Court, Maitland Park Estate, London, NW3 2EH

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	77.6	(1a) x	2.6	(2a) =	201.76 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.6	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	201.76 (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) =	0.15 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.4 (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			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)

Infiltration rate modified for monthly wind speed

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

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

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

0.47	0.46	0.45	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43
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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) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

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

0 (23c)

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

(24a)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (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
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 (24b)

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

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

(24c)m=

0	0	0	0	0	0	0	0	0	0	0	0
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 (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=

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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 (24d)

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

(25)m=

0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m ²)	Openings m ²	Net Area A ,m ²	U-value W/m ² K	A X U (W/K)	k-value kJ/m ² -K	A X k kJ/K
Windows Type 1			5.48	x1/[1/(1.4)+ 0.04] =	7.27		(27)
Windows Type 2			2.16	x1/[1/(1.4)+ 0.04] =	2.86		(27)
Windows Type 3			1.79	x1/[1/(1.4)+ 0.04] =	2.37		(27)
Windows Type 4			3.27	x1/[1/(1.4)+ 0.04] =	4.34		(27)
Windows Type 5			1.79	x1/[1/(1.4)+ 0.04] =	2.37		(27)
Windows Type 6			4.93	x1/[1/(1.4)+ 0.04] =	6.54		(27)
Walls	56.73	19.42	37.31	x 0.18 =	6.72		(29)
Total area of elements, m ²			56.73				(31)
Party wall			34.53	x 0 =	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 32.46 (33)

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

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.67 (36)

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

Total fabric heat loss (33) + (36) = 37.14 (37)

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

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
40.65	40.36	40.08	38.77	38.52	37.38	37.38	37.16	37.82	38.52	39.02	39.54

 (38)

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

(39)m=

77.79	77.5	77.22	75.91	75.66	74.51	74.51	74.3	74.95	75.66	76.16	76.68
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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1	1	1	0.98	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.99	
Average = Sum(40) _{1...12} / 12 =												0.98	(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 2.42 (42)
 if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)
 if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 91.57 (43)
 Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	100.73	97.07	93.41	89.74	86.08	82.42	82.42	86.08	89.74	93.41	97.07	100.73	(44)
Total = Sum(44) _{1...12} =												1098.89	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	149.38	130.65	134.82	117.54	112.78	97.32	90.18	103.49	104.72	122.04	133.22	144.67	(45)
Total = Sum(45) _{1...12} =												1440.81	

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=	22.41	19.6	20.22	17.63	16.92	14.6	13.53	15.52	15.71	18.31	19.98	21.7	(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)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.98	172.74	181.41	162.63	159.38	142.41	136.78	150.08	149.81	168.64	178.31	191.26	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	195.98	172.74	181.41	162.63	159.38	142.41	136.78	150.08	149.81	168.64	178.31	191.26	
Output from water heater (annual) _{1...12}												(64)	
												1989.43	

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

(65)m=	86.95	77.11	82.1	75.16	74.78	68.43	67.26	71.69	70.89	77.86	80.37	85.38	(65)
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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=	120.79	120.79	120.79	120.79	120.79	120.79	120.79	120.79	120.79	120.79	120.79	120.79	(66)

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

(67)m=	19.11	16.97	13.8	10.45	7.81	6.59	7.13	9.26	12.43	15.79	18.42	19.64	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	214.35	216.58	210.97	199.04	183.98	169.82	160.36	158.14	163.74	175.67	190.74	204.89	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.08	35.08	35.08	35.08	35.08	35.08	35.08	35.08	35.08	35.08	35.08	35.08	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	-96.63	(71)
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Water heating gains (Table 5)

(72)m=	116.86	114.75	110.35	104.38	100.5	95.05	90.41	96.35	98.46	104.64	111.62	114.76	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	412.56	410.53	397.36	376.11	354.53	333.69	320.13	325.99	336.87	358.34	383.02	401.53	(73)
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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	x	Area m ²	x	Flux Table 6a	x	g _g Table 6b	x	FF Table 6c	=	Gains (W)			
North	0.9x		0.77	x	5.48	x	10.63	x	0.63	x	0.7	=	17.81	(74)
North	0.9x		0.77	x	4.93	x	10.63	x	0.63	x	0.7	=	16.02	(74)
North	0.9x		0.77	x	5.48	x	20.32	x	0.63	x	0.7	=	34.03	(74)
North	0.9x		0.77	x	4.93	x	20.32	x	0.63	x	0.7	=	30.62	(74)
North	0.9x		0.77	x	5.48	x	34.53	x	0.63	x	0.7	=	57.83	(74)

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North	0.9x	0.77	x	4.93	x	34.53	x	0.63	x	0.7	=	52.03	(74)
North	0.9x	0.77	x	5.48	x	55.46	x	0.63	x	0.7	=	92.89	(74)
North	0.9x	0.77	x	4.93	x	55.46	x	0.63	x	0.7	=	83.57	(74)
North	0.9x	0.77	x	5.48	x	74.72	x	0.63	x	0.7	=	125.13	(74)
North	0.9x	0.77	x	4.93	x	74.72	x	0.63	x	0.7	=	112.57	(74)
North	0.9x	0.77	x	5.48	x	79.99	x	0.63	x	0.7	=	133.96	(74)
North	0.9x	0.77	x	4.93	x	79.99	x	0.63	x	0.7	=	120.51	(74)
North	0.9x	0.77	x	5.48	x	74.68	x	0.63	x	0.7	=	125.07	(74)
North	0.9x	0.77	x	4.93	x	74.68	x	0.63	x	0.7	=	112.51	(74)
North	0.9x	0.77	x	5.48	x	59.25	x	0.63	x	0.7	=	99.22	(74)
North	0.9x	0.77	x	4.93	x	59.25	x	0.63	x	0.7	=	89.26	(74)
North	0.9x	0.77	x	5.48	x	41.52	x	0.63	x	0.7	=	69.53	(74)
North	0.9x	0.77	x	4.93	x	41.52	x	0.63	x	0.7	=	62.55	(74)
North	0.9x	0.77	x	5.48	x	24.19	x	0.63	x	0.7	=	40.51	(74)
North	0.9x	0.77	x	4.93	x	24.19	x	0.63	x	0.7	=	36.45	(74)
North	0.9x	0.77	x	5.48	x	13.12	x	0.63	x	0.7	=	21.97	(74)
North	0.9x	0.77	x	4.93	x	13.12	x	0.63	x	0.7	=	19.76	(74)
North	0.9x	0.77	x	5.48	x	8.86	x	0.63	x	0.7	=	14.85	(74)
North	0.9x	0.77	x	4.93	x	8.86	x	0.63	x	0.7	=	13.36	(74)
East	0.9x	0.77	x	2.16	x	19.64	x	0.63	x	0.7	=	12.97	(76)
East	0.9x	0.77	x	1.79	x	19.64	x	0.63	x	0.7	=	10.74	(76)
East	0.9x	0.77	x	3.27	x	19.64	x	0.63	x	0.7	=	19.63	(76)
East	0.9x	0.77	x	2.16	x	38.42	x	0.63	x	0.7	=	25.36	(76)
East	0.9x	0.77	x	1.79	x	38.42	x	0.63	x	0.7	=	21.02	(76)
East	0.9x	0.77	x	3.27	x	38.42	x	0.63	x	0.7	=	38.4	(76)
East	0.9x	0.77	x	2.16	x	63.27	x	0.63	x	0.7	=	41.77	(76)
East	0.9x	0.77	x	1.79	x	63.27	x	0.63	x	0.7	=	34.61	(76)
East	0.9x	0.77	x	3.27	x	63.27	x	0.63	x	0.7	=	63.23	(76)
East	0.9x	0.77	x	2.16	x	92.28	x	0.63	x	0.7	=	60.92	(76)
East	0.9x	0.77	x	1.79	x	92.28	x	0.63	x	0.7	=	50.48	(76)
East	0.9x	0.77	x	3.27	x	92.28	x	0.63	x	0.7	=	92.22	(76)
East	0.9x	0.77	x	2.16	x	113.09	x	0.63	x	0.7	=	74.66	(76)
East	0.9x	0.77	x	1.79	x	113.09	x	0.63	x	0.7	=	61.87	(76)
East	0.9x	0.77	x	3.27	x	113.09	x	0.63	x	0.7	=	113.02	(76)
East	0.9x	0.77	x	2.16	x	115.77	x	0.63	x	0.7	=	76.42	(76)
East	0.9x	0.77	x	1.79	x	115.77	x	0.63	x	0.7	=	63.33	(76)
East	0.9x	0.77	x	3.27	x	115.77	x	0.63	x	0.7	=	115.7	(76)
East	0.9x	0.77	x	2.16	x	110.22	x	0.63	x	0.7	=	72.76	(76)
East	0.9x	0.77	x	1.79	x	110.22	x	0.63	x	0.7	=	60.29	(76)
East	0.9x	0.77	x	3.27	x	110.22	x	0.63	x	0.7	=	110.15	(76)
East	0.9x	0.77	x	2.16	x	94.68	x	0.63	x	0.7	=	62.5	(76)

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East	0.9x	0.77	x	1.79	x	94.68	x	0.63	x	0.7	=	51.79	(76)
East	0.9x	0.77	x	3.27	x	94.68	x	0.63	x	0.7	=	94.61	(76)
East	0.9x	0.77	x	2.16	x	73.59	x	0.63	x	0.7	=	48.58	(76)
East	0.9x	0.77	x	1.79	x	73.59	x	0.63	x	0.7	=	40.26	(76)
East	0.9x	0.77	x	3.27	x	73.59	x	0.63	x	0.7	=	73.54	(76)
East	0.9x	0.77	x	2.16	x	45.59	x	0.63	x	0.7	=	30.09	(76)
East	0.9x	0.77	x	1.79	x	45.59	x	0.63	x	0.7	=	24.94	(76)
East	0.9x	0.77	x	3.27	x	45.59	x	0.63	x	0.7	=	45.56	(76)
East	0.9x	0.77	x	2.16	x	24.49	x	0.63	x	0.7	=	16.17	(76)
East	0.9x	0.77	x	1.79	x	24.49	x	0.63	x	0.7	=	13.4	(76)
East	0.9x	0.77	x	3.27	x	24.49	x	0.63	x	0.7	=	24.47	(76)
East	0.9x	0.77	x	2.16	x	16.15	x	0.63	x	0.7	=	10.66	(76)
East	0.9x	0.77	x	1.79	x	16.15	x	0.63	x	0.7	=	8.84	(76)
East	0.9x	0.77	x	3.27	x	16.15	x	0.63	x	0.7	=	16.14	(76)
West	0.9x	0.77	x	1.79	x	19.64	x	0.63	x	0.7	=	10.74	(80)
West	0.9x	0.77	x	1.79	x	38.42	x	0.63	x	0.7	=	21.02	(80)
West	0.9x	0.77	x	1.79	x	63.27	x	0.63	x	0.7	=	34.61	(80)
West	0.9x	0.77	x	1.79	x	92.28	x	0.63	x	0.7	=	50.48	(80)
West	0.9x	0.77	x	1.79	x	113.09	x	0.63	x	0.7	=	61.87	(80)
West	0.9x	0.77	x	1.79	x	115.77	x	0.63	x	0.7	=	63.33	(80)
West	0.9x	0.77	x	1.79	x	110.22	x	0.63	x	0.7	=	60.29	(80)
West	0.9x	0.77	x	1.79	x	94.68	x	0.63	x	0.7	=	51.79	(80)
West	0.9x	0.77	x	1.79	x	73.59	x	0.63	x	0.7	=	40.26	(80)
West	0.9x	0.77	x	1.79	x	45.59	x	0.63	x	0.7	=	24.94	(80)
West	0.9x	0.77	x	1.79	x	24.49	x	0.63	x	0.7	=	13.4	(80)
West	0.9x	0.77	x	1.79	x	16.15	x	0.63	x	0.7	=	8.84	(80)

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

(83)m=	87.91	170.44	284.08	430.56	549.11	573.25	541.07	449.18	334.72	202.49	109.17	72.68	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	500.47	580.98	681.45	806.66	903.64	906.95	861.2	775.17	671.59	560.83	492.19	474.2	(84)
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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.9	0.73	0.52	0.38	0.44	0.72	0.95	0.99	1	(86)

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

(87)m=	20.01	20.16	20.43	20.76	20.94	20.99	21	21	20.96	20.69	20.29	19.98	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.08	20.08	20.09	20.1	20.1	20.12	20.12	20.12	20.11	20.1	20.1	20.09	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.87	0.67	0.45	0.3	0.36	0.65	0.94	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.75	18.99	19.38	19.83	20.05	20.11	20.12	20.12	20.08	19.75	19.18	18.73	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$fLA = \text{Living area} \div (4) =$ 0.36 (91)

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

(92)m=	19.21	19.42	19.76	20.17	20.38	20.43	20.44	20.44	20.4	20.09	19.58	19.19	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.21	19.42	19.76	20.17	20.38	20.43	20.44	20.44	20.4	20.09	19.58	19.19	(93)
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8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ 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, h_m :

(94)m=	0.99	0.99	0.96	0.88	0.69	0.48	0.33	0.39	0.67	0.93	0.99	1	(94)
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Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	497.93	574.11	657.01	706.08	624.14	431.45	285.6	299.29	452.27	524.24	486.61	472.38	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1159.66	1124.99	1023.98	855.51	656.5	434.6	285.91	300.02	472.35	717.9	950.67	1149.11	(97)
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Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	492.33	370.19	273.03	107.59	24.07	0	0	0	0	144.08	334.12	503.49	
$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1...5,9...12} =$												2248.91	(98)

Space heating requirement in $kWh/m^2/year$

28.98 (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 $(204) = (202) \times [1 - (203)] =$ 1 (204)

Efficiency of main space heating system 1 93.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

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

492.33	370.19	273.03	107.59	24.07	0	0	0	0	144.08	334.12	503.49
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$(211)m = \{ [(98)m \times (204)] \} \times 100 \div (206)$ (211)

	526.56	395.93	292.01	115.07	25.75	0	0	0	0	154.1	357.35	538.49	
$\text{Total (kWh/year)} = \text{Sum}(211)_{1...5,10...12} =$												2405.25	(211)

Space heating fuel (secondary), $kWh/month$

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

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

Water heating

Output from water heater (calculated above)

195.98	172.74	181.41	162.63	159.38	142.41	136.78	150.08	149.81	168.64	178.31	191.26
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Efficiency of water heater 79.8 (216)

TER WorkSheet: New dwelling design stage

(217)m=	87.17	86.8	85.9	83.74	81.06	79.8	79.8	79.8	79.8	84.4	86.47	87.28	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	224.82	199.01	211.19	194.2	196.62	178.46	171.4	188.07	187.74	199.81	206.22	219.14		
Total = Sum(219a) _{1..12} =												2376.69	(219)	

Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		2405.25
Water heating fuel used		2376.69
Electricity for pumps, fans and electric keep-hot		
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75 (231)
Electricity for lighting		337.48 (232)

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	=	519.53 (261)
Space heating (secondary)	(215) x		0.519	=	0 (263)
Water heating	(219) x		0.216	=	513.36 (264)
Space and water heating	(261) + (262) + (263) + (264) =				1032.9 (265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93 (267)
Electricity for lighting	(232) x		0.519	=	175.15 (268)
Total CO2, kg/year	sum of (265)...(271) =				1246.98 (272)
TER =					16.07 (273)