

DER WorkSheet: New dwelling design stage

User Details:

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Software Name:	Stroma FSAP 2012	Software Version:	Version: 1.0.4.10

Property Address: House Type D01

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	41.31	(1a) x	2.37	(2a) =	97.9
First floor	34.79	(1b) x	2.7	(2b) =	93.93
Second floor	28.02	(1c) x	2.7	(2c) =	75.65
Third floor	3.61	(1d) x	2.9	(2d) =	10.47
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.73	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	277.96

2. Ventilation rate:

	main heating	secondary heating	other	total		m ³ per hour
Number of chimneys	0	+	0	+	0	x 40 = 0
Number of open flues	0	+	0	+	0	x 20 = 0
Number of intermittent fans				0	x 10 =	0
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) =	0	÷ (5) =	0
<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
Additional infiltration		[(9)-1]x0.1 =	0
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0
If no draught lobby, enter 0.05, else enter 0			0
Percentage of windows and doors draught stripped			0
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18
<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
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.92
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.16
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

	0.21	0.2	0.2	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19
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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) × 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) × [1 – (23c) ÷ 100]

(24a)m=	0.36	0.36	0.35	0.33	0.33	0.31	0.31	0.31	0.32	0.33	0.34	0.35
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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 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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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=	0.36	0.36	0.35	0.33	0.33	0.31	0.31	0.31	0.32	0.33	0.34	0.35
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(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows Type 1			21.31	x 1/[1/(1.2)+ 0.04] =	24.4		(27)
Windows Type 2			12.05	x 1/[1/(1.2)+ 0.04] =	13.8		(27)
Floor			41.31	x 0.14	= 5.7834		(28)
Walls Type1	76.28	35.63	40.65	x 0.18	= 7.32		(29)
Walls Type2	42.05	0	42.05	x 0.18	= 7.57		(29)
Roof Type1	37.7	0	37.7	x 0.12	= 4.52		(30)
Roof Type2	4.09	0	4.09	x 0.12	= 0.49		(30)
Total area of elements, m²			201.43				(31)
Party wall			101.37	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) = 66.61 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 19098.61 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

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can be used instead of a detailed calculation.

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

15

(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(33) + (36) =

81.61

(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
33.22	32.85	32.48	30.62	30.25	28.39	28.39	28.02	29.13	30.25	30.99	31.73

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

114.82	114.45	114.08	112.23	111.86	110	110	109.63	110.74	111.86	112.6	113.34
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Average = Sum(39)_{1...12} / 12 =

112.13

(39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

1.07	1.06	1.06	1.04	1.04	1.02	1.02	1.02	1.03	1.04	1.05	1.05
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Average = Sum(40)_{1...12} / 12 =

1.04

(40)

Number of days in month (Table 1a)

(41)m=

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

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.8

(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

100.71

(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 Vd,m = factor from Table 1c x (43)

(44)m=

110.78	106.75	102.73	98.7	94.67	90.64	90.64	94.67	98.7	102.73	106.75	110.78
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Total = Sum(44)_{1...12} =

1208.54

(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=

164.29	143.69	148.27	129.27	124.04	107.03	99.18	113.81	115.17	134.22	146.51	159.1
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Total = Sum(45)_{1...12} =

1584.59

(45)

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

(46)m=

24.64	21.55	22.24	19.39	18.61	16.05	14.88	17.07	17.28	20.13	21.98	23.87
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(46)

Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0
0

(54)

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

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0
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(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	0	0	0	0	0	0	0	0	0	0	0
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(59)

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

(61)m=	26.5	23.92	26.43	25.51	26.29	25.37	26.17	26.25	25.44	26.37	25.59	26.48
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(61)

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

(62)m=	190.79	167.6	174.7	154.77	150.33	132.4	125.35	140.06	140.61	160.59	172.1	185.58
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(62)

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

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

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

Output from water heater

(64)m=	190.79	167.6	174.7	154.77	150.33	132.4	125.35	140.06	140.61	160.59	172.1	185.58
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Output from water heater (annual)_{1...12}

1894.89

(64)

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

(65)m=	61.25	53.75	55.91	49.36	47.81	41.93	39.52	44.4	44.66	51.22	55.11	59.52
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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=	140.02	140.02	140.02	140.02	140.02	140.02	140.02	140.02	140.02	140.02	140.02	140.02

(66)

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

(67)m=	23.91	21.24	17.27	13.08	9.78	8.25	8.92	11.59	15.56	19.75	23.06	24.58
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(67)

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

(68)m=	268.25	271.04	264.02	249.09	230.24	212.52	200.69	197.9	204.92	219.85	238.7	256.42
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(68)

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

(69)m=	37	37	37	37	37	37	37	37	37	37	37	37
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(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3
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(70)

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

(71)m=	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02	-112.02
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(71)

Water heating gains (Table 5)

(72)m=	82.33	79.99	75.15	68.55	64.27	58.24	53.12	59.68	62.02	68.84	76.55	80
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(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=	442.5	440.28	424.45	398.73	372.29	347.02	330.73	337.18	350.5	376.46	406.31	429.01
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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)	
Northeast 0.9x	0.77	x	12.05	x	11.28	x	0.63	x	0.7	=	41.55	(75)
Northeast 0.9x	0.77	x	12.05	x	22.97	x	0.63	x	0.7	=	84.58	(75)
Northeast 0.9x	0.77	x	12.05	x	41.38	x	0.63	x	0.7	=	152.38	(75)
Northeast 0.9x	0.77	x	12.05	x	67.96	x	0.63	x	0.7	=	250.26	(75)
Northeast 0.9x	0.77	x	12.05	x	91.35	x	0.63	x	0.7	=	336.39	(75)
Northeast 0.9x	0.77	x	12.05	x	97.38	x	0.63	x	0.7	=	358.63	(75)
Northeast 0.9x	0.77	x	12.05	x	91.1	x	0.63	x	0.7	=	335.49	(75)
Northeast 0.9x	0.77	x	12.05	x	72.63	x	0.63	x	0.7	=	267.46	(75)
Northeast 0.9x	0.77	x	12.05	x	50.42	x	0.63	x	0.7	=	185.68	(75)
Northeast 0.9x	0.77	x	12.05	x	28.07	x	0.63	x	0.7	=	103.36	(75)
Northeast 0.9x	0.77	x	12.05	x	14.2	x	0.63	x	0.7	=	52.28	(75)
Northeast 0.9x	0.77	x	12.05	x	9.21	x	0.63	x	0.7	=	33.93	(75)
Southeast 0.9x	0.77	x	21.31	x	36.79	x	0.63	x	0.7	=	239.62	(77)
Southeast 0.9x	0.77	x	21.31	x	62.67	x	0.63	x	0.7	=	408.17	(77)
Southeast 0.9x	0.77	x	21.31	x	85.75	x	0.63	x	0.7	=	558.47	(77)
Southeast 0.9x	0.77	x	21.31	x	106.25	x	0.63	x	0.7	=	691.98	(77)
Southeast 0.9x	0.77	x	21.31	x	119.01	x	0.63	x	0.7	=	775.07	(77)
Southeast 0.9x	0.77	x	21.31	x	118.15	x	0.63	x	0.7	=	769.47	(77)
Southeast 0.9x	0.77	x	21.31	x	113.91	x	0.63	x	0.7	=	741.85	(77)
Southeast 0.9x	0.77	x	21.31	x	104.39	x	0.63	x	0.7	=	679.85	(77)
Southeast 0.9x	0.77	x	21.31	x	92.85	x	0.63	x	0.7	=	604.71	(77)
Southeast 0.9x	0.77	x	21.31	x	69.27	x	0.63	x	0.7	=	451.11	(77)
Southeast 0.9x	0.77	x	21.31	x	44.07	x	0.63	x	0.7	=	287.01	(77)
Southeast 0.9x	0.77	x	21.31	x	31.49	x	0.63	x	0.7	=	205.07	(77)

Solar gains in watts, calculated for each month

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

(83)m=	281.17	492.75	710.86	942.23	1111.46	1128.1	1077.34	947.31	790.39	554.47	339.3	239	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	723.68	933.02	1135.31	1340.96	1483.75	1475.12	1408.07	1284.5	1140.89	930.93	745.61	668.01	(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=	0.96	0.92	0.85	0.74	0.6	0.44	0.33	0.38	0.58	0.81	0.93	0.96	(86)

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

(87)m=	18.91	19.31	19.82	20.37	20.73	20.92	20.97	20.96	20.82	20.3	19.5	18.84	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.03	20.03	20.03	20.05	20.05	20.07	20.07	20.07	20.06	20.05	20.05	20.04	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.95	0.91	0.83	0.71	0.55	0.39	0.27	0.3	0.52	0.78	0.92	0.96	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.23	17.81	18.54	19.29	19.76	19.99	20.05	20.04	19.89	19.22	18.1	17.14	(90)
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fLA = Living area ÷ (4) =	0.2	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.57	18.12	18.8	19.51	19.96	20.18	20.24	20.23	20.08	19.44	18.38	17.48	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.57	18.12	18.8	19.51	19.96	20.18	20.24	20.23	20.08	19.44	18.38	17.48	(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=	0.93	0.88	0.81	0.69	0.55	0.39	0.28	0.32	0.52	0.76	0.89	0.94	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	670.93	819.44	914.37	925.63	811.87	582.25	391.65	407.57	592.67	705.03	664.4	626.61	(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=	1523.89	1512.82	1403.14	1190.92	923.68	613.76	400.02	419.81	661.84	988.45	1270.32	1505.44	(97)
--------	---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

(98)m=	634.61	465.95	363.65	191.01	83.19	0	0	0	0	210.86	436.27	653.85		
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													3039.38	(98)

Space heating requirement in kWh/m²/year

28.21	(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

93.2	(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)

634.61	465.95	363.65	191.01	83.19	0	0	0	0	210.86	436.27	653.85
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

680.91	499.95	390.18	204.94	89.26	0	0	0	0	226.25	468.1	701.56
--------	--------	--------	--------	-------	---	---	---	---	--------	-------	--------

Total (kWh/year) =Sum(211) _{1...5,10...12} =	3261.14	(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		
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

190.79	167.6	174.7	154.77	150.33	132.4	125.35	140.06	140.61	160.59	172.1	185.58
--------	-------	-------	--------	--------	-------	--------	--------	--------	--------	-------	--------

Efficiency of water heater	87.3	(216)
----------------------------	------	-------

DER WorkSheet: New dwelling design stage

(217)m=

89.51	89.41	89.24	88.88	88.31	87.3	87.3	87.3	87.3	88.92	89.36	89.54
-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

213.14	187.45	195.77	174.14	170.22	151.66	143.58	160.43	161.07	180.59	192.6	207.26
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

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

2137.91

 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

356.07

 (230a)

central heating pump:

30

 (230c)

boiler with a fan-assisted flue

45

 (230e)

Total electricity for the above, kWh/year

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

431.07

 (231)

Electricity for lighting

422.35

 (232)

Electricity generated by PVs

-509.54

 (233)

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	=	704.41 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	461.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1166.19 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	223.72 (267)
Electricity for lighting	(232) x	0.519	=	219.2 (268)
Energy saving/generation technologies Item 1		0.519	=	-264.45 (269)
Total CO2, kg/year	sum of (265)...(271) =			1344.67 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			12.48 (273)
EI rating (section 14)				88 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: House Type D02

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	39.32 (1a)	x	2.37 (2a)	=	93.19 (3a)
First floor	39.32 (1b)	x	2.7 (2b)	=	106.16 (3b)
Second floor	28.12 (1c)	x	2.7 (2c)	=	75.92 (3c)
Third floor	3.61 (1d)	x	2.9 (2d)	=	10.47 (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.37 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	285.75 (5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ 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			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18 (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) =		0.15 (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
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
--	------	------	------	------	------	------	------	------	------	------	------	------

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) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

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

68.85 (23c)

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

(24a)m=	0.35	0.34	0.34	0.32	0.32	0.3	0.3	0.29	0.3	0.32	0.32	0.33
---------	------	------	------	------	------	-----	-----	------	-----	------	------	------

(24a)

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

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

(24b)

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

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

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

(24c)

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

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

(24d)m=	0	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=	0.35	0.34	0.34	0.32	0.32	0.3	0.3	0.29	0.3	0.32	0.32	0.33
--------	------	------	------	------	------	-----	-----	------	-----	------	------	------

(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows			21.31	x 1/[1/(1.2)+0.04]	= 24.4		(27)
Floor			39.32	x 0.14	= 5.5048		(28)
Walls Type1	37.71	23.58	14.13	x 0.18	= 2.54		(29)
Walls Type2	30.46	0	30.46	x 0.18	= 5.48		(29)
Roof Type1	35.71	0	35.71	x 0.12	= 4.29		(30)
Roof Type2	4.09	0	4.09	x 0.12	= 0.49		(30)
Total area of elements, m²			147.29				(31)
Party wall			150.31	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) = 45.43 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 22491.74 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

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can be used instead of a detailed calculation.

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

10 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(33) + (36) =

55.43 (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
32.57	32.22	31.87	30.12	29.77	28.01	28.01	27.66	28.71	29.77	30.47	31.17

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

88	87.65	87.3	85.55	85.2	83.44	83.44	83.09	84.14	85.2	85.9	86.6
----	-------	------	-------	------	-------	-------	-------	-------	------	------	------

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

85.46 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

0.8	0.79	0.79	0.78	0.77	0.76	0.76	0.75	0.76	0.77	0.78	0.78
-----	------	------	------	------	------	------	------	------	------	------	------

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

0.77 (40)

Number of days in month (Table 1a)

(41)m=

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

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.82

(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

101.1

(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=

111.21	107.17	103.13	99.08	95.04	90.99	90.99	95.04	99.08	103.13	107.17	111.21
--------	--------	--------	-------	-------	-------	-------	-------	-------	--------	--------	--------

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

1213.25 (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=

164.93	144.25	148.85	129.77	124.52	107.45	99.57	114.26	115.62	134.74	147.08	159.72
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

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

1590.77 (45)

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

(46)m=

24.74	21.64	22.33	19.47	18.68	16.12	14.94	17.14	17.34	20.21	22.06	23.96
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

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Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0
0

(54)

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

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

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

(56)

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

(57)m=

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

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

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

(59)

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

(61)m=

26.5	23.92	26.43	25.51	26.29	25.37	26.17	26.25	25.45	26.37	25.59	26.48
------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=

191.43	168.17	175.28	155.28	150.81	132.82	125.74	140.51	141.07	161.11	172.68	186.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(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=

191.43	168.17	175.28	155.28	150.81	132.82	125.74	140.51	141.07	161.11	172.68	186.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1901.11

(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=

61.46	53.94	56.1	49.53	47.98	42.07	39.65	44.55	44.81	51.39	55.3	59.73
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------

(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
140.85	140.85	140.85	140.85	140.85	140.85	140.85	140.85	140.85	140.85	140.85	140.85

(66)

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

(67)m=

24.53	21.78	17.72	13.41	10.03	8.46	9.15	11.89	15.96	20.26	23.65	25.21
-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------

(67)

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

(68)m=

272.09	274.91	267.8	252.65	233.53	215.56	203.55	200.73	207.84	222.99	242.11	260.08
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(68)

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

(69)m=

37.09	37.09	37.09	37.09	37.09	37.09	37.09	37.09	37.09	37.09	37.09	37.09
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=

-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68	-112.68
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=

82.61	80.27	75.4	68.79	64.48	58.43	53.29	59.88	62.23	69.08	76.81	80.28
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

447.48	445.22	429.17	403.1	376.29	350.71	334.25	340.76	354.29	380.59	410.82	433.83
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

(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 _u Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	21.31	x	36.79	x	0.63	x	0.7	=	239.62	(77)
Southeast 0.9x	0.77	x	21.31	x	62.67	x	0.63	x	0.7	=	408.17	(77)
Southeast 0.9x	0.77	x	21.31	x	85.75	x	0.63	x	0.7	=	558.47	(77)
Southeast 0.9x	0.77	x	21.31	x	106.25	x	0.63	x	0.7	=	691.98	(77)
Southeast 0.9x	0.77	x	21.31	x	119.01	x	0.63	x	0.7	=	775.07	(77)
Southeast 0.9x	0.77	x	21.31	x	118.15	x	0.63	x	0.7	=	769.47	(77)
Southeast 0.9x	0.77	x	21.31	x	113.91	x	0.63	x	0.7	=	741.85	(77)
Southeast 0.9x	0.77	x	21.31	x	104.39	x	0.63	x	0.7	=	679.85	(77)
Southeast 0.9x	0.77	x	21.31	x	92.85	x	0.63	x	0.7	=	604.71	(77)
Southeast 0.9x	0.77	x	21.31	x	69.27	x	0.63	x	0.7	=	451.11	(77)
Southeast 0.9x	0.77	x	21.31	x	44.07	x	0.63	x	0.7	=	287.01	(77)
Southeast 0.9x	0.77	x	21.31	x	31.49	x	0.63	x	0.7	=	205.07	(77)

Solar gains in watts, calculated for each month

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

(83)m=	239.62	408.17	558.47	691.98	775.07	769.47	741.85	679.85	604.71	451.11	287.01	205.07	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	687.11	853.39	987.64	1095.08	1151.36	1120.17	1076.09	1020.61	958.99	831.7	697.84	638.89	(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=	0.96	0.92	0.85	0.75	0.61	0.46	0.34	0.37	0.56	0.8	0.93	0.96	(86)

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

(87)m=	19.5	19.84	20.22	20.6	20.84	20.96	20.99	20.98	20.91	20.58	19.98	19.44	(87)
--------	------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.29	20.28	20.27	20.27	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.95	0.91	0.84	0.72	0.58	0.41	0.28	0.31	0.51	0.77	0.91	0.96	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.23	18.71	19.25	19.79	20.1	20.25	20.28	20.28	20.2	19.77	18.93	18.15	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.18 (91)

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

(92)m=	18.46	18.92	19.43	19.93	20.23	20.38	20.41	20.41	20.33	19.92	19.12	18.39	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.46	18.92	19.43	19.93	20.23	20.38	20.41	20.41	20.33	19.92	19.12	18.39	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.93	0.89	0.82	0.71	0.58	0.42	0.29	0.32	0.51	0.75	0.89	0.94	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

DER WorkSheet: New dwelling design stage

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

(95)m=	640.92	755.86	807.95	779.48	662.25	466.91	314.67	328.51	492.01	627.5	624.46	602.73	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

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

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

(97)m=	1245.9	1228.46	1128.49	943.9	726.94	482.28	318.03	333.21	524.18	794.09	1032.58	1228.6	(97)
--------	--------	---------	---------	-------	--------	--------	--------	--------	--------	--------	---------	--------	------

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

(98)m=	450.11	317.59	238.49	118.38	48.13	0	0	0	0	123.94	293.84	465.65	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 2056.12 (98)

Space heating requirement in kWh/m²/year

18.63	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

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

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

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

Efficiency of main space heating system 1 93.2 (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)

450.11	317.59	238.49	118.38	48.13	0	0	0	0	123.94	293.84	465.65
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

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

482.95	340.76	255.89	127.01	51.64	0	0	0	0	132.98	315.28	499.62
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 2206.14 (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	
Total (kWh/year) =Sum(215) _{1...5,10...12} = 0													(215)

Water heating

Output from water heater (calculated above)

191.43	168.17	175.28	155.28	150.81	132.82	125.74	140.51	141.07	161.11	172.68	186.21
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 87.3 (216)

(217)m= 89.31 89.17 88.95 88.53 87.98 87.3 87.3 87.3 87.3 88.54 89.1 89.35 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.34	188.58	197.06	175.4	171.41	152.14	144.03	160.95	161.59	181.97	193.79	208.4	
Total = Sum(219a) _{1...12} = 2149.65													(219)

Annual totals

Space heating fuel used, main system 1 kWh/year 2206.14 kWh/year

Water heating fuel used 2149.65

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 366.04 (230a)

DER WorkSheet: New dwelling design stage

central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	441.04	(231)
Electricity for lighting		433.15	(232)
Electricity generated by PVs		-509.54	(233)

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	=	476.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	464.33	(264)
Space and water heating	(261) + (262) + (263) + (264) =			940.85	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	228.9	(267)
Electricity for lighting	(232) x	0.519	=	224.81	(268)
Energy saving/generation technologies Item 1		0.519	=	-264.45	(269)
Total CO2, kg/year		sum of (265)...(271) =		1130.11	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.24	(273)
El rating (section 14)				90	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr
Software Name: Stroma FSAP 2012

Stroma Number: STRO028460
Software Version: Version: 1.0.4.10

Property Address: House Type E01

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	54.71 (1a)	x	2.37 (2a)	=	129.66 (3a)
First floor	49.94 (1b)	x	2.7 (2b)	=	134.84 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	104.65 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	264.5 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	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			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18 (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) =		0.16 (21)

Infiltration rate modified for monthly wind speed

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

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.21	0.2	0.2	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19
--	------	-----	-----	------	------	------	------	------	------	------	------	------

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) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

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

68 (23c)

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

(24a)m= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (24a)

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

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

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

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

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

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

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

(24d)m= 0 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= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows Type 1			11.09	x 1/[1/(1.2)+ 0.04]	= 12.7		(27)
Windows Type 2			12.19	x 1/[1/(1.2)+ 0.04]	= 13.96		(27)
Windows Type 3			9.42	x 1/[1/(1.2)+ 0.04]	= 10.79		(27)
Floor			54.71	x 0.14	= 7.6594		(28)
Walls	107.76	34.97	72.79	x 0.18	= 13.1		(29)
Roof Type1	4.78	0	4.78	x 0.12	= 0.57		(30)
Roof Type2	49.94	0	49.94	x 0.12	= 5.99		(30)
Total area of elements, m²			217.19				(31)
Party wall			47.42	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) = 67.49 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 16094.18 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 15 (36)

DER WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 82.49 (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=	31.98	31.63	31.27	29.51	29.15	27.39	27.39	27.04	28.09	29.15	29.86	30.57	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	114.48	114.12	113.77	112	111.65	109.88	109.88	109.53	110.59	111.65	112.36	113.06	
Average = Sum(39) _{1...12} /12=												111.91	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.09	1.09	1.09	1.07	1.07	1.05	1.05	1.05	1.06	1.07	1.07	1.08	
Average = Sum(40) _{1...12} /12=												1.07	(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 2.78 (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) + 36 100.19 (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=	110.21	106.2	102.2	98.19	94.18	90.17	90.17	94.18	98.19	102.2	106.2	110.21	
Total = Sum(44) _{1...12} =												1202.3	(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=	163.44	142.95	147.51	128.6	123.39	106.48	98.67	113.22	114.58	133.53	145.76	158.28	
Total = Sum(45) _{1...12} =												1576.41	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.52	21.44	22.13	19.29	18.51	15.97	14.8	16.98	17.19	20.03	21.86	23.74	(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) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

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

 (56)

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

(57)m=

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

 (57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

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

 (59)

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

(61)m=

26.5	23.91	26.43	25.5	26.29	25.36	26.16	26.24	25.44	26.36	25.59	26.47
------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

189.94	166.86	173.93	154.1	149.68	131.84	124.83	139.47	140.01	159.89	171.34	184.76
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 (62)

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

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

(63)m=

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

 (63)

Output from water heater

(64)m=

189.94	166.86	173.93	154.1	149.68	131.84	124.83	139.47	140.01	159.89	171.34	184.76
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual) _{1...12}											1886.66
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 (64)

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

(65)m=

60.97	53.51	55.65	49.13	47.6	41.75	39.35	44.21	44.46	50.99	54.86	59.25
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 (65)

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

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93	138.93

 (66)

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

(67)m=

23.5	20.88	16.98	12.85	9.61	8.11	8.76	11.39	15.29	19.41	22.66	24.16
------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------

 (67)

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

(68)m=

263.63	266.37	259.48	244.8	226.27	208.86	197.23	194.49	201.39	216.06	234.59	252
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 (68)

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

(69)m=

36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14	-111.14
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

81.95	79.62	74.8	68.24	63.98	57.98	52.89	59.42	61.74	68.53	76.2	79.63
-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------	-------

 (72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

436.76	434.55	418.93	393.57	367.54	342.63	326.56	332.98	346.1	371.69	401.12	423.47
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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)	
Northeast 0.9x	0.77	x	11.09	x	11.28	x	0.63	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	11.09	x	22.97	x	0.63	x	0.7	=	77.84	(75)
Northeast 0.9x	0.77	x	11.09	x	41.38	x	0.63	x	0.7	=	140.24	(75)
Northeast 0.9x	0.77	x	11.09	x	67.96	x	0.63	x	0.7	=	230.32	(75)
Northeast 0.9x	0.77	x	11.09	x	91.35	x	0.63	x	0.7	=	309.59	(75)
Northeast 0.9x	0.77	x	11.09	x	97.38	x	0.63	x	0.7	=	330.06	(75)
Northeast 0.9x	0.77	x	11.09	x	91.1	x	0.63	x	0.7	=	308.76	(75)
Northeast 0.9x	0.77	x	11.09	x	72.63	x	0.63	x	0.7	=	246.15	(75)
Northeast 0.9x	0.77	x	11.09	x	50.42	x	0.63	x	0.7	=	170.89	(75)
Northeast 0.9x	0.77	x	11.09	x	28.07	x	0.63	x	0.7	=	95.13	(75)
Northeast 0.9x	0.77	x	11.09	x	14.2	x	0.63	x	0.7	=	48.12	(75)
Northeast 0.9x	0.77	x	11.09	x	9.21	x	0.63	x	0.7	=	31.23	(75)
Southeast 0.9x	0.77	x	9.42	x	36.79	x	0.63	x	0.7	=	105.92	(77)
Southeast 0.9x	0.77	x	9.42	x	62.67	x	0.63	x	0.7	=	180.43	(77)
Southeast 0.9x	0.77	x	9.42	x	85.75	x	0.63	x	0.7	=	246.87	(77)
Southeast 0.9x	0.77	x	9.42	x	106.25	x	0.63	x	0.7	=	305.89	(77)
Southeast 0.9x	0.77	x	9.42	x	119.01	x	0.63	x	0.7	=	342.62	(77)
Southeast 0.9x	0.77	x	9.42	x	118.15	x	0.63	x	0.7	=	340.14	(77)
Southeast 0.9x	0.77	x	9.42	x	113.91	x	0.63	x	0.7	=	327.93	(77)
Southeast 0.9x	0.77	x	9.42	x	104.39	x	0.63	x	0.7	=	300.53	(77)
Southeast 0.9x	0.77	x	9.42	x	92.85	x	0.63	x	0.7	=	267.31	(77)
Southeast 0.9x	0.77	x	9.42	x	69.27	x	0.63	x	0.7	=	199.41	(77)
Southeast 0.9x	0.77	x	9.42	x	44.07	x	0.63	x	0.7	=	126.87	(77)
Southeast 0.9x	0.77	x	9.42	x	31.49	x	0.63	x	0.7	=	90.65	(77)
Southwest 0.9x	0.77	x	12.19	x	36.79		0.63	x	0.7	=	137.07	(79)
Southwest 0.9x	0.77	x	12.19	x	62.67		0.63	x	0.7	=	233.49	(79)
Southwest 0.9x	0.77	x	12.19	x	85.75		0.63	x	0.7	=	319.46	(79)
Southwest 0.9x	0.77	x	12.19	x	106.25		0.63	x	0.7	=	395.83	(79)
Southwest 0.9x	0.77	x	12.19	x	119.01		0.63	x	0.7	=	443.36	(79)
Southwest 0.9x	0.77	x	12.19	x	118.15		0.63	x	0.7	=	440.16	(79)
Southwest 0.9x	0.77	x	12.19	x	113.91		0.63	x	0.7	=	424.36	(79)
Southwest 0.9x	0.77	x	12.19	x	104.39		0.63	x	0.7	=	388.9	(79)
Southwest 0.9x	0.77	x	12.19	x	92.85		0.63	x	0.7	=	345.91	(79)
Southwest 0.9x	0.77	x	12.19	x	69.27		0.63	x	0.7	=	258.05	(79)
Southwest 0.9x	0.77	x	12.19	x	44.07		0.63	x	0.7	=	164.18	(79)
Southwest 0.9x	0.77	x	12.19	x	31.49		0.63	x	0.7	=	117.31	(79)

Solar gains in watts, calculated for each month

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

(83)m= 281.24 491.75 706.58 932.04 1095.58 1110.36 1061.05 935.58 784.11 552.59 339.17 239.18 (83)

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

(84)m= 718 926.3 1125.51 1325.61 1463.11 1452.99 1387.61 1268.56 1130.21 924.28 740.3 662.65 (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=	0.95	0.92	0.85	0.74	0.6	0.45	0.34	0.38	0.58	0.81	0.93	0.96	(86)

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

(87)m=	18.86	19.27	19.79	20.34	20.71	20.91	20.97	20.96	20.81	20.27	19.46	18.79	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.01	20.01	20.01	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.02	20.02	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.95	0.9	0.83	0.71	0.55	0.39	0.27	0.31	0.52	0.78	0.91	0.96	(89)
--------	------	-----	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	17.16	17.74	18.47	19.24	19.72	19.96	20.02	20.02	19.85	19.17	18.03	17.06	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.16 (91)

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

(92)m=	17.42	17.98	18.68	19.41	19.87	20.11	20.17	20.16	20	19.34	18.26	17.33	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------

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

(93)m=	17.42	17.98	18.68	19.41	19.87	20.11	20.17	20.16	20	19.34	18.26	17.33	(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=	0.92	0.87	0.8	0.69	0.55	0.39	0.28	0.32	0.52	0.75	0.89	0.93	(94)
--------	------	------	-----	------	------	------	------	------	------	------	------	------	------

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

(95)m=	663.07	809.32	901.28	910.88	798.72	572.73	383.69	399.61	583.01	695.02	656.33	619.4	(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=	1502.33	1493.15	1385.83	1177.22	912.67	605.35	392.34	412.16	652.77	976.08	1253.58	1484.54	(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=	624.41	459.54	360.51	191.77	84.78	0	0	0	0	209.11	430.02	643.67	(98)
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 3003.8 (98)

Space heating requirement in kWh/m²/year

28.7 (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 93.2 (206)

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)													
	624.41	459.54	360.51	191.77	84.78	0	0	0	0	209.11	430.02	643.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)													
	669.97	493.07	386.81	205.76	90.97	0	0	0	0	224.37	461.39	690.63	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													3222.96 (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	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	189.94	166.86	173.93	154.1	149.68	131.84	124.83	139.47	140.01	159.89	171.34	184.76	
Efficiency of water heater													87.3 (216)
(217)m=	89.51	89.41	89.24	88.88	88.33	87.3	87.3	87.3	87.3	88.92	89.35	89.54	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	212.21	186.62	194.92	173.37	169.46	151.02	142.99	159.76	160.38	179.82	191.76	206.35	
Total = Sum(219a) _{1..12} =													2128.65 (219)
Annual totals													
													kWh/year
Space heating fuel used, main system 1													3222.96
Water heating fuel used													2128.65
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													391.26 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												466.26 (231)
Electricity for lighting													415.07 (232)
Electricity generated by PVs													-509.54 (233)

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	=	696.16 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	459.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1155.95 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	241.99 (267)
Electricity for lighting	(232) x	0.519	=	215.42 (268)
Energy saving/generation technologies				
Item 1		0.519	=	-264.45 (269)

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Total CO2, kg/year	sum of (265)...(271) =	1348.91	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	12.89	(273)
El rating (section 14)		88	(274)

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User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: House Type E02

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	46.57 (1a)	x	2.37 (2a)	=	110.37 (3a)
First floor	44.55 (1b)	x	2.7 (2b)	=	120.29 (3b)
Second floor	23.13 (1c)	x	2.39 (2c)	=	55.28 (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	114.25 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	285.94 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18 (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) =		0.15 (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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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
--	------	------	------	------	------	------	------	------	------	------	------	------

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) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

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

68 (23c)

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

(24a)m=	0.35	0.35	0.34	0.32	0.32	0.3	0.3	0.3	0.31	0.32	0.33	0.33	(24a)
---------	------	------	------	------	------	-----	-----	-----	------	------	------	------	-------

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

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

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

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

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

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

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

(24d)m=	0	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=	0.35	0.35	0.34	0.32	0.32	0.3	0.3	0.3	0.31	0.32	0.33	0.33	(25)
--------	------	------	------	------	------	-----	-----	-----	------	------	------	------	------

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows Type 1			6.45	x 1/[1/(1.2) + 0.04]	= 7.39		(27)
Windows Type 2			11.27	x 1/[1/(1.2) + 0.04]	= 12.9		(27)
Rooflights			2.21	x 1/[1/(1.2) + 0.04]	= 2.652		(27b)
Floor			46.57	x 0.14	= 6.5198		(28)
Walls Type1	50.48	19.99	30.49	x 0.18	= 5.49		(29)
Walls Type2	17.44	0	17.44	x 0.17	= 2.96		(29)
Roof Type1	21.42	2.21	19.21	x 0.09	= 1.76		(30)
Roof Type2	9.03	0	9.03	x 0.1	= 0.9		(30)
Roof Type3	2.02	0	2.02	x 0.12	= 0.24		(30)
Roof Type4	16.28	0	16.28	x 0.12	= 1.95		(30)
Total area of elements, m²			163.24				(31)
Party wall			119.89	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) = 45.37 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 20715.82 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

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can be used instead of a detailed calculation.

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

14 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss

(33) + (36) =

59.37 (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=	32.99	32.64	32.29	30.54	30.19	28.43	28.43	28.08	29.13	30.19	30.89	31.59

(38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=	92.36	92.01	91.66	89.91	89.56	87.8	87.8	87.45	88.5	89.56	90.26	90.96
--------	-------	-------	-------	-------	-------	------	------	-------	------	-------	-------	-------

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

89.82 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.81	0.81	0.8	0.79	0.78	0.77	0.77	0.77	0.77	0.78	0.79	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

2.84

(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

101.6

(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=	111.76	107.7	103.64	99.57	95.51	91.44	91.44	95.51	99.57	103.64	107.7	111.76
--------	--------	-------	--------	-------	-------	-------	-------	-------	-------	--------	-------	--------

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

1219.25 (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=	165.74	144.96	149.59	130.41	125.13	107.98	100.06	114.82	116.19	135.41	147.81	160.51
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1598.63 (45)

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

(46)m=	24.86	21.74	22.44	19.56	18.77	16.2	15.01	17.22	17.43	20.31	22.17	24.08
--------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------

(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) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0
0

(54)

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

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

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

(56)

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

(57)m=

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

(57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

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

(59)

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

(61)m=

26.51	23.92	26.44	25.52	26.3	25.38	26.17	26.26	25.45	26.37	25.6	26.48
-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------	-------

(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=

192.25	168.88	176.02	155.93	151.43	133.36	126.23	141.08	141.64	161.78	173.41	187
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

(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=

192.25	168.88	176.02	155.93	151.43	133.36	126.23	141.08	141.64	161.78	173.41	187
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-----

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

1909.02 (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=

61.74	54.18	56.35	49.74	48.18	42.25	39.81	44.74	45	51.62	55.55	59.99
-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------

(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
141.9	141.9	141.9	141.9	141.9	141.9	141.9	141.9	141.9	141.9	141.9	141.9

(66)

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

(67)m=

25.31	22.48	18.28	13.84	10.34	8.73	9.44	12.27	16.46	20.9	24.4	26.01
-------	-------	-------	-------	-------	------	------	-------	-------	------	------	-------

(67)

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

(68)m=

277.53	280.41	273.15	257.7	238.2	219.87	207.62	204.74	212	227.45	246.95	265.28
--------	--------	--------	-------	-------	--------	--------	--------	-----	--------	--------	--------

(68)

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

(69)m=

37.19	37.19	37.19	37.19	37.19	37.19	37.19	37.19	37.19	37.19	37.19	37.19
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(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=

-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52	-113.52
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

(71)

Water heating gains (Table 5)

(72)m=

82.98	80.62	75.73	69.08	64.76	58.68	53.51	60.14	62.5	69.38	77.15	80.63
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

(72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

454.38	452.08	435.73	409.19	381.87	355.85	339.14	345.72	359.53	386.3	417.07	440.5
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------

(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	6.45	x	11.28	x	0.63	x	0.7	=	22.24	(75)
Northeast 0.9x	0.77	x	6.45	x	22.97	x	0.63	x	0.7	=	45.27	(75)
Northeast 0.9x	0.77	x	6.45	x	41.38	x	0.63	x	0.7	=	81.57	(75)
Northeast 0.9x	0.77	x	6.45	x	67.96	x	0.63	x	0.7	=	133.95	(75)
Northeast 0.9x	0.77	x	6.45	x	91.35	x	0.63	x	0.7	=	180.06	(75)
Northeast 0.9x	0.77	x	6.45	x	97.38	x	0.63	x	0.7	=	191.96	(75)
Northeast 0.9x	0.77	x	6.45	x	91.1	x	0.63	x	0.7	=	179.58	(75)
Northeast 0.9x	0.77	x	6.45	x	72.63	x	0.63	x	0.7	=	143.16	(75)
Northeast 0.9x	0.77	x	6.45	x	50.42	x	0.63	x	0.7	=	99.39	(75)
Northeast 0.9x	0.77	x	6.45	x	28.07	x	0.63	x	0.7	=	55.33	(75)
Northeast 0.9x	0.77	x	6.45	x	14.2	x	0.63	x	0.7	=	27.98	(75)
Northeast 0.9x	0.77	x	6.45	x	9.21	x	0.63	x	0.7	=	18.16	(75)
Southwest 0.9x	0.77	x	11.27	x	36.79		0.63	x	0.7	=	126.73	(79)
Southwest 0.9x	0.77	x	11.27	x	62.67		0.63	x	0.7	=	215.86	(79)
Southwest 0.9x	0.77	x	11.27	x	85.75		0.63	x	0.7	=	295.35	(79)
Southwest 0.9x	0.77	x	11.27	x	106.25		0.63	x	0.7	=	365.96	(79)
Southwest 0.9x	0.77	x	11.27	x	119.01		0.63	x	0.7	=	409.9	(79)
Southwest 0.9x	0.77	x	11.27	x	118.15		0.63	x	0.7	=	406.94	(79)
Southwest 0.9x	0.77	x	11.27	x	113.91		0.63	x	0.7	=	392.33	(79)
Southwest 0.9x	0.77	x	11.27	x	104.39		0.63	x	0.7	=	359.55	(79)
Southwest 0.9x	0.77	x	11.27	x	92.85		0.63	x	0.7	=	319.81	(79)
Southwest 0.9x	0.77	x	11.27	x	69.27		0.63	x	0.7	=	238.58	(79)
Southwest 0.9x	0.77	x	11.27	x	44.07		0.63	x	0.7	=	151.79	(79)
Southwest 0.9x	0.77	x	11.27	x	31.49		0.63	x	0.7	=	108.45	(79)
Rooflights 0.9x	1	x	2.21	x	18.07	x	0.63	x	0.7	=	15.85	(82)
Rooflights 0.9x	1	x	2.21	x	37.96	x	0.63	x	0.7	=	33.3	(82)
Rooflights 0.9x	1	x	2.21	x	71.02	x	0.63	x	0.7	=	62.3	(82)
Rooflights 0.9x	1	x	2.21	x	119.98	x	0.63	x	0.7	=	105.24	(82)
Rooflights 0.9x	1	x	2.21	x	163.58	x	0.63	x	0.7	=	143.49	(82)
Rooflights 0.9x	1	x	2.21	x	175.24	x	0.63	x	0.7	=	153.71	(82)
Rooflights 0.9x	1	x	2.21	x	163.61	x	0.63	x	0.7	=	143.51	(82)
Rooflights 0.9x	1	x	2.21	x	129.11	x	0.63	x	0.7	=	113.25	(82)
Rooflights 0.9x	1	x	2.21	x	87.66	x	0.63	x	0.7	=	76.9	(82)
Rooflights 0.9x	1	x	2.21	x	47.1	x	0.63	x	0.7	=	41.31	(82)
Rooflights 0.9x	1	x	2.21	x	22.95	x	0.63	x	0.7	=	20.13	(82)
Rooflights 0.9x	1	x	2.21	x	14.62	x	0.63	x	0.7	=	12.82	(82)

Solar gains in watts, calculated for each month

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

(83)m= 164.82 294.43 439.22 605.15 733.45 752.62 715.42 615.96 496.09 335.22 199.91 139.44 (83)

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

(84)m= 619.2 746.51 874.95 1014.35 1115.33 1108.47 1054.56 961.68 855.62 721.52 616.98 579.93 (84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.97	0.95	0.9	0.8	0.65	0.48	0.36	0.41	0.63	0.86	0.95	0.97	(86)

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

(87)m=	19.33	19.62	20.03	20.5	20.8	20.95	20.99	20.98	20.87	20.44	19.81	19.28	(87)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20.25	20.25	20.25	20.26	20.27	20.28	20.28	20.28	20.28	20.27	20.26	20.26	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.97	0.94	0.88	0.77	0.61	0.43	0.3	0.35	0.58	0.84	0.94	0.97	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

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

(90)m=	17.97	18.4	18.98	19.64	20.05	20.23	20.27	20.27	20.14	19.58	18.68	17.91	(90)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) = 0.11 (91)

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

(92)m=	18.12	18.53	19.09	19.73	20.13	20.31	20.35	20.34	20.22	19.67	18.79	18.06	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.12	18.53	19.09	19.73	20.13	20.31	20.35	20.34	20.22	19.67	18.79	18.06	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.95	0.92	0.86	0.75	0.6	0.44	0.31	0.35	0.58	0.81	0.92	0.96	(94)
--------	------	------	------	------	-----	------	------	------	------	------	------	------	------

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

(95)m=	588.3	685.35	753.49	765.19	674.35	482.19	324.56	337.99	492.89	587.36	569.85	555.41	(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=	1276.06	1253.79	1154.45	973.89	754.51	501.08	328.84	344.68	541.6	812.1	1055.52	1260.59	(97)
--------	---------	---------	---------	--------	--------	--------	--------	--------	-------	-------	---------	---------	------

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

(98)m=	511.7	382	298.31	150.26	59.64	0	0	0	0	167.21	349.68	524.65	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												2443.45	(98)

Space heating requirement in kWh/m²/year

21.39 (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 93.2 (206)

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	511.7	382	298.31	150.26	59.64	0	0	0	0	167.21	349.68	524.65	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)													
	549.03	409.87	320.08	161.23	63.99	0	0	0	0	179.41	375.2	562.93	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													2621.73 (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	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	192.25	168.88	176.02	155.93	151.43	133.36	126.23	141.08	141.64	161.78	173.41	187	
Efficiency of water heater													87.3 (216)
(217)m=	89.39	89.29	89.1	88.7	88.1	87.3	87.3	87.3	87.3	88.75	89.22	89.42	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	215.07	189.14	197.55	175.79	171.89	152.76	144.6	161.6	162.25	182.29	194.37	209.12	
Total = Sum(219a) _{1..12} =													2156.43 (219)
Annual totals													
	kWh/year												kWh/year
Space heating fuel used, main system 1													2621.73
Water heating fuel used													2156.43
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													422.97 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												497.97 (231)
Electricity for lighting													446.92 (232)
Electricity generated by PVs													-509.54 (233)

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 =	566.29 (261)
Space heating (secondary)	(215) x	0.519 =	0 (263)
Water heating	(219) x	0.216 =	465.79 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1032.08 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	258.45 (267)
Electricity for lighting	(232) x	0.519 =	231.95 (268)
Energy saving/generation technologies			
Item 1		0.519 =	-264.45 (269)

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Total CO2, kg/year	sum of (265)...(271) =	1258.03	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	11.01	(273)
El rating (section 14)		89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: House Type E03

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50.82 (1a)	x	2.37 (2a)	=	120.44 (3a)
First floor	48.8 (1b)	x	2.7 (2b)	=	131.76 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	99.62 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	252.2 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	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			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18 (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) =		0.16 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.21	0.2	0.2	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19
--	------	-----	-----	------	------	------	------	------	------	------	------	------

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) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

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

68 (23c)

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

(24a)m= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (24a)

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

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

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

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

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

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

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

(24d)m= 0 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= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows Type 1			9.11	x 1/[1/(1.2)+0.04]	= 10.43		(27)
Windows Type 2			11.56	x 1/[1/(1.2)+0.04]	= 13.24		(27)
Windows Type 3			7.04	x 1/[1/(1.2)+0.04]	= 8.06		(27)
Floor			50.82	x 0.14	= 7.1148		(28)
Walls	97.97	29.98	67.99	x 0.18	= 12.24		(29)
Roof Type1	2.02	0	2.02	x 0.12	= 0.24		(30)
Roof Type2	48.8	0	48.8	x 0.1	= 4.88		(30)
Total area of elements, m²			199.61				(31)
Party wall			44.24	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) = 58.93 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14993.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 15 (36)

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if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 73.93 (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=	30.49	30.16	29.82	28.14	27.8	26.12	26.12	25.78	26.79	27.8	28.47	29.15	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	104.42	104.09	103.75	102.06	101.73	100.04	100.04	99.71	100.72	101.73	102.4	103.07	
Average = Sum(39) _{1...12} /12=												101.98	(39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.05	1.04	1.04	1.02	1.02	1	1	1	1.01	1.02	1.03	1.03	
Average = Sum(40) _{1...12} /12=												1.02	(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 2.74 (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 99.18 (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=	109.1	105.13	101.16	97.2	93.23	89.26	89.26	93.23	97.2	101.16	105.13	109.1	
Total = Sum(44) _{1...12} =												1190.15	(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=	161.79	141.5	146.02	127.3	122.15	105.4	97.67	112.08	113.42	132.18	144.28	156.68	
Total = Sum(45) _{1...12} =												1560.48	(45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.27	21.23	21.9	19.1	18.32	15.81	14.65	16.81	17.01	19.83	21.64	23.5	(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) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

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

 (56)

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

(57)m=

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

 (57)

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=

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

 (59)

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

(61)m=

26.49	23.91	26.42	25.49	26.27	25.35	26.15	26.23	25.43	26.36	25.58	26.47
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 (61)

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

(62)m=

188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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=

188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Output from water heater (annual)_{1...12} 1870.63 (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=

60.42	53.03	55.16	48.7	47.18	41.39	39.01	43.83	44.07	50.54	54.37	58.71
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 (65)

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

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8

 (66)

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

(67)m=

22.8	20.25	16.47	12.47	9.32	7.87	8.5	11.05	14.83	18.83	21.98	23.43
------	-------	-------	-------	------	------	-----	-------	-------	-------	-------	-------

 (67)

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

(68)m=

255.71	258.37	251.68	237.44	219.47	202.59	191.3	188.65	195.34	209.57	227.54	244.43
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

81.21	78.91	74.13	67.64	63.42	57.48	52.44	58.9	61.21	67.93	75.51	78.92
-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------

 (72)

Total internal gains =

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

(73)m=

426.75	424.56	409.32	384.59	359.25	334.97	319.28	325.64	338.41	363.37	392.07	413.82
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 (73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	7.04	x	11.28	x	0.63	x	0.7	=	24.28	(75)
Northeast 0.9x	0.77	x	7.04	x	22.97	x	0.63	x	0.7	=	49.41	(75)
Northeast 0.9x	0.77	x	7.04	x	41.38	x	0.63	x	0.7	=	89.03	(75)
Northeast 0.9x	0.77	x	7.04	x	67.96	x	0.63	x	0.7	=	146.21	(75)
Northeast 0.9x	0.77	x	7.04	x	91.35	x	0.63	x	0.7	=	196.53	(75)
Northeast 0.9x	0.77	x	7.04	x	97.38	x	0.63	x	0.7	=	209.52	(75)
Northeast 0.9x	0.77	x	7.04	x	91.1	x	0.63	x	0.7	=	196.01	(75)
Northeast 0.9x	0.77	x	7.04	x	72.63	x	0.63	x	0.7	=	156.26	(75)
Northeast 0.9x	0.77	x	7.04	x	50.42	x	0.63	x	0.7	=	108.48	(75)
Northeast 0.9x	0.77	x	7.04	x	28.07	x	0.63	x	0.7	=	60.39	(75)
Northeast 0.9x	0.77	x	7.04	x	14.2	x	0.63	x	0.7	=	30.54	(75)
Northeast 0.9x	0.77	x	7.04	x	9.21	x	0.63	x	0.7	=	19.82	(75)
Southeast 0.9x	0.77	x	11.56	x	36.79	x	0.63	x	0.7	=	129.99	(77)
Southeast 0.9x	0.77	x	11.56	x	62.67	x	0.63	x	0.7	=	221.42	(77)
Southeast 0.9x	0.77	x	11.56	x	85.75	x	0.63	x	0.7	=	302.95	(77)
Southeast 0.9x	0.77	x	11.56	x	106.25	x	0.63	x	0.7	=	375.37	(77)
Southeast 0.9x	0.77	x	11.56	x	119.01	x	0.63	x	0.7	=	420.45	(77)
Southeast 0.9x	0.77	x	11.56	x	118.15	x	0.63	x	0.7	=	417.41	(77)
Southeast 0.9x	0.77	x	11.56	x	113.91	x	0.63	x	0.7	=	402.43	(77)
Southeast 0.9x	0.77	x	11.56	x	104.39	x	0.63	x	0.7	=	368.8	(77)
Southeast 0.9x	0.77	x	11.56	x	92.85	x	0.63	x	0.7	=	328.04	(77)
Southeast 0.9x	0.77	x	11.56	x	69.27	x	0.63	x	0.7	=	244.71	(77)
Southeast 0.9x	0.77	x	11.56	x	44.07	x	0.63	x	0.7	=	155.7	(77)
Southeast 0.9x	0.77	x	11.56	x	31.49	x	0.63	x	0.7	=	111.24	(77)
Northwest 0.9x	0.77	x	9.11	x	11.28	x	0.63	x	0.7	=	31.41	(81)
Northwest 0.9x	0.77	x	9.11	x	22.97	x	0.63	x	0.7	=	63.94	(81)
Northwest 0.9x	0.77	x	9.11	x	41.38	x	0.63	x	0.7	=	115.2	(81)
Northwest 0.9x	0.77	x	9.11	x	67.96	x	0.63	x	0.7	=	189.2	(81)
Northwest 0.9x	0.77	x	9.11	x	91.35	x	0.63	x	0.7	=	254.32	(81)
Northwest 0.9x	0.77	x	9.11	x	97.38	x	0.63	x	0.7	=	271.13	(81)
Northwest 0.9x	0.77	x	9.11	x	91.1	x	0.63	x	0.7	=	253.64	(81)
Northwest 0.9x	0.77	x	9.11	x	72.63	x	0.63	x	0.7	=	202.2	(81)
Northwest 0.9x	0.77	x	9.11	x	50.42	x	0.63	x	0.7	=	140.38	(81)
Northwest 0.9x	0.77	x	9.11	x	28.07	x	0.63	x	0.7	=	78.14	(81)
Northwest 0.9x	0.77	x	9.11	x	14.2	x	0.63	x	0.7	=	39.53	(81)
Northwest 0.9x	0.77	x	9.11	x	9.21	x	0.63	x	0.7	=	25.65	(81)

Solar gains in watts, calculated for each month

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

(83)m= 185.68 334.77 507.19 710.78 871.3 898.07 852.07 727.26 576.89 383.24 225.77 156.72 (83)

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

(84)m= 612.43 759.33 916.5 1095.37 1230.55 1233.04 1171.35 1052.9 915.31 746.62 617.84 570.54 (84)

DER WorkSheet: New dwelling design stage

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=	0.96	0.94	0.88	0.78	0.63	0.48	0.36	0.41	0.63	0.85	0.94	0.97	(86)

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

(87)m=	18.86	19.2	19.71	20.29	20.69	20.9	20.97	20.95	20.78	20.21	19.43	18.8	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.04	20.05	20.05	20.06	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.05	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.96	0.93	0.87	0.75	0.59	0.42	0.29	0.34	0.57	0.82	0.93	0.96	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.17	17.67	18.38	19.2	19.73	19.99	20.06	20.05	19.86	19.11	18	17.09	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	----	-------	------

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	17.4	17.88	18.57	19.35	19.86	20.12	20.19	20.18	19.99	19.26	18.2	17.33	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(93)m=	17.4	17.88	18.57	19.35	19.86	20.12	20.19	20.18	19.99	19.26	18.2	17.33	(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=	0.94	0.9	0.84	0.73	0.58	0.42	0.3	0.35	0.57	0.8	0.91	0.95	(94)
--------	------	-----	------	------	------	------	-----	------	------	-----	------	------	------

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

(95)m=	573.97	683.41	767.39	796.78	715.42	519.69	350.05	363.35	517.56	593.92	561.16	539.72	(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)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

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

(97)m=	1368.19	1351.37	1252.1	1066.43	830.35	552.22	358.74	376.5	592.89	881.19	1136.89	1353.32	(97)
--------	---------	---------	--------	---------	--------	--------	--------	-------	--------	--------	---------	---------	------

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

(98)m=	590.9	448.86	360.63	194.15	85.5	0	0	0	0	213.73	414.52	605.32	(98)
--------	-------	--------	--------	--------	------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 2913.61 (98)

Space heating requirement in kWh/m²/year

29.25 (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 93.2 (206)

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	590.9	448.86	360.63	194.15	85.5	0	0	0	0	213.73	414.52	605.32	
(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)													
	634.02	481.61	386.94	208.31	91.74	0	0	0	0	229.32	444.77	649.49	
Total (kWh/year) = Sum(211) _{1..5,10...12} =													3126.19 (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	
Total (kWh/year) = Sum(215) _{1..5,10...12} =													0 (215)
Water heating													
Output from water heater (calculated above)													
	188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15	
Efficiency of water heater													87.3 (216)
(217)m=	89.48	89.4	89.24	88.9	88.34	87.3	87.3	87.3	87.3	88.94	89.34	89.51	(217)
Fuel for water heating, kWh/month													
(219)m = (64)m x 100 ÷ (217)m													
(219)m=	210.41	185.02	193.22	171.87	168.02	149.78	141.84	158.43	159.05	178.25	190.14	204.62	
Total = Sum(219a) _{1..12} =													2110.64 (219)
Annual totals													
	kWh/year												kWh/year
Space heating fuel used, main system 1													3126.19
Water heating fuel used													2110.64
Electricity for pumps, fans and electric keep-hot													
mechanical ventilation - balanced, extract or positive input from outside													373.07 (230a)
central heating pump:													30 (230c)
boiler with a fan-assisted flue													45 (230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =												448.07 (231)
Electricity for lighting													402.6 (232)
Electricity generated by PVs													-509.54 (233)

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	=	675.26 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	455.9 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1131.16 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	232.55 (267)
Electricity for lighting	(232) x	0.519	=	208.95 (268)
Energy saving/generation technologies				
Item 1		0.519	=	-264.45 (269)

DER WorkSheet: New dwelling design stage

Total CO2, kg/year	sum of (265)...(271) =	1308.21	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	13.13	(273)
El rating (section 14)		88	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr
Software Name: Stroma FSAP 2012

Stroma Number: STRO028460
Software Version: Version: 1.0.4.10

Property Address: House Type E04

Address :

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	50.82 (1a)	x	2.37 (2a)	=	120.44 (3a)
First floor	48.8 (1b)	x	2.7 (2b)	=	131.76 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	99.62 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	252.2 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	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			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.18 (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) =		0.16 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

	0.21	0.2	0.2	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19
--	------	-----	-----	------	------	------	------	------	------	------	------	------

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) × Fmv (equation (N5)) , otherwise (23b) = (23a)

0.5 (23b)

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

68 (23c)

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

(24a)m= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (24a)

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

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

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

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

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

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

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

(24d)m= 0 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= 0.37 0.36 0.36 0.34 0.33 0.31 0.31 0.31 0.32 0.33 0.34 0.35 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.27	x 1.2	= 2.724		(26)
Windows Type 1			9.11	x 1/[1/(1.2)+0.04]	= 10.43		(27)
Windows Type 2			11.56	x 1/[1/(1.2)+0.04]	= 13.24		(27)
Floor			50.82	x 0.14	= 7.1148		(28)
Walls	51.65	22.94	28.71	x 0.18	= 5.17		(29)
Roof Type1	2.02	0	2.02	x 0.12	= 0.24		(30)
Roof Type2	48.8	0	48.8	x 0.1	= 4.88		(30)
Total area of elements, m²			153.29				(31)
Party wall			90.57	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) = 43.8 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 17732.88 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 15 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 58.8 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

(38)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30.49	30.16	29.82	28.14	27.8	26.12	26.12	25.78	26.79	27.8	28.47	29.15

(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=

89.29	88.95	88.62	86.93	86.6	84.91	84.91	84.58	85.59	86.6	87.27	87.94
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$$\text{Average} = \text{Sum}(39)_{1...12} / 12 =$$

86.85

(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=

0.9	0.89	0.89	0.87	0.87	0.85	0.85	0.85	0.86	0.87	0.88	0.88
-----	------	------	------	------	------	------	------	------	------	------	------

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

0.87

(40)

Number of days in month (Table 1a)

(41)m=

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

(41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.74

(42)

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

if TFA ≤ 13.9, N = 1

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

99.18

(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 $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=

109.1	105.13	101.16	97.2	93.23	89.26	89.26	93.23	97.2	101.16	105.13	109.1
-------	--------	--------	------	-------	-------	-------	-------	------	--------	--------	-------

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

1190.15

(44)

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

(45)m=

161.79	141.5	146.02	127.3	122.15	105.4	97.67	112.08	113.42	132.18	144.28	156.68
--------	-------	--------	-------	--------	-------	-------	--------	--------	--------	--------	--------

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

1560.48

(45)

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

(46)m=

24.27	21.23	21.9	19.1	18.32	15.81	14.65	16.81	17.01	19.83	21.64	23.5
-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	------

(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

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=

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

(56)

DER WorkSheet: New dwelling design stage

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

(57)m=

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

 (57)

Primary circuit loss (annual) from Table 3

0

 (58)

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

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

(59)m=

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

 (59)

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

(61)m=

26.49	23.91	26.42	25.49	26.27	25.35	26.15	26.23	25.43	26.36	25.58	26.47
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 (61)

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

(62)m=

188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15
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 (62)

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

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

(63)m=

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

 (63)

Output from water heater

(64)m=

188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

1870.63

 (64)

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

(65)m=

60.42	53.03	55.16	48.7	47.18	41.39	39.01	43.83	44.07	50.54	54.37	58.71
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 (65)

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

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

Metabolic gains (Table 5), Watts

(66)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8	136.8

 (66)

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

(67)m=

22.88	20.32	16.53	12.51	9.35	7.9	8.53	11.09	14.89	18.9	22.06	23.52
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 (67)

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

(68)m=

255.71	258.37	251.68	237.44	219.47	202.59	191.3	188.65	195.34	209.57	227.54	244.43
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------

 (68)

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

(69)m=

36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68	36.68
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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=

-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44	-109.44
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

81.21	78.91	74.13	67.64	63.42	57.48	52.44	58.9	61.21	67.93	75.51	78.92
-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------

 (72)

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

(73)m=

426.84	424.63	409.38	384.63	359.28	335	319.31	325.68	338.47	363.44	392.15	413.9
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 (73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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DER WorkSheet: New dwelling design stage

Northeast 0.9x	0.77	x	9.11	x	11.28	x	0.63	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	9.11	x	22.97	x	0.63	x	0.7	=	63.94	(75)
Northeast 0.9x	0.77	x	9.11	x	41.38	x	0.63	x	0.7	=	115.2	(75)
Northeast 0.9x	0.77	x	9.11	x	67.96	x	0.63	x	0.7	=	189.2	(75)
Northeast 0.9x	0.77	x	9.11	x	91.35	x	0.63	x	0.7	=	254.32	(75)
Northeast 0.9x	0.77	x	9.11	x	97.38	x	0.63	x	0.7	=	271.13	(75)
Northeast 0.9x	0.77	x	9.11	x	91.1	x	0.63	x	0.7	=	253.64	(75)
Northeast 0.9x	0.77	x	9.11	x	72.63	x	0.63	x	0.7	=	202.2	(75)
Northeast 0.9x	0.77	x	9.11	x	50.42	x	0.63	x	0.7	=	140.38	(75)
Northeast 0.9x	0.77	x	9.11	x	28.07	x	0.63	x	0.7	=	78.14	(75)
Northeast 0.9x	0.77	x	9.11	x	14.2	x	0.63	x	0.7	=	39.53	(75)
Northeast 0.9x	0.77	x	9.11	x	9.21	x	0.63	x	0.7	=	25.65	(75)
Southwest 0.9x	0.77	x	11.56	x	36.79		0.63	x	0.7	=	129.99	(79)
Southwest 0.9x	0.77	x	11.56	x	62.67		0.63	x	0.7	=	221.42	(79)
Southwest 0.9x	0.77	x	11.56	x	85.75		0.63	x	0.7	=	302.95	(79)
Southwest 0.9x	0.77	x	11.56	x	106.25		0.63	x	0.7	=	375.37	(79)
Southwest 0.9x	0.77	x	11.56	x	119.01		0.63	x	0.7	=	420.45	(79)
Southwest 0.9x	0.77	x	11.56	x	118.15		0.63	x	0.7	=	417.41	(79)
Southwest 0.9x	0.77	x	11.56	x	113.91		0.63	x	0.7	=	402.43	(79)
Southwest 0.9x	0.77	x	11.56	x	104.39		0.63	x	0.7	=	368.8	(79)
Southwest 0.9x	0.77	x	11.56	x	92.85		0.63	x	0.7	=	328.04	(79)
Southwest 0.9x	0.77	x	11.56	x	69.27		0.63	x	0.7	=	244.71	(79)
Southwest 0.9x	0.77	x	11.56	x	44.07		0.63	x	0.7	=	155.7	(79)
Southwest 0.9x	0.77	x	11.56	x	31.49		0.63	x	0.7	=	111.24	(79)

Solar gains in watts, calculated for each month

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

(83)m=

161.4	285.36	418.16	564.57	674.77	688.54	656.07	571	468.41	322.86	195.22	136.9
-------	--------	--------	--------	--------	--------	--------	-----	--------	--------	--------	-------

 (83)

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

(84)m=

588.24	709.99	827.54	949.21	1034.06	1023.54	975.38	896.69	806.88	686.3	587.37	550.8
--------	--------	--------	--------	---------	---------	--------	--------	--------	-------	--------	-------

 (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
0.96	0.94	0.89	0.79	0.66	0.49	0.37	0.42	0.63	0.85	0.94	0.97

 (86)

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

(87)m=

19.18	19.49	19.92	20.41	20.75	20.93	20.98	20.97	20.84	20.37	19.69	19.14
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (87)

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

(88)m=

20.17	20.17	20.18	20.19	20.19	20.21	20.21	20.21	20.2	20.19	20.19	20.18
-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------

 (88)

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

(89)m=

0.96	0.93	0.88	0.77	0.62	0.44	0.31	0.35	0.58	0.82	0.93	0.97
------	------	------	------	------	------	------	------	------	------	------	------

 (89)

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

DER WorkSheet: New dwelling design stage

(90)m=	17.71	18.16	18.77	19.46	19.91	20.14	20.19	20.19	20.04	19.42	18.47	17.65	(90)
fLA = Living area ÷ (4) =												0.14	(91)

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

(92)m=	17.92	18.35	18.93	19.6	20.03	20.25	20.3	20.3	20.15	19.56	18.64	17.86	(92)
--------	-------	-------	-------	------	-------	-------	------	------	-------	-------	-------	-------	------

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

(93)m=	17.92	18.35	18.93	19.6	20.03	20.25	20.3	20.3	20.15	19.56	18.64	17.86	(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=	0.94	0.91	0.85	0.75	0.61	0.45	0.32	0.36	0.57	0.8	0.91	0.95	(94)
--------	------	------	------	------	------	------	------	------	------	-----	------	------	------

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

(95)m=	553.68	644.06	703.79	711.45	630.04	455.71	308.49	320.83	463.51	550.45	536.11	523.03	(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=	1216.25	1196.18	1101.65	929.78	721.31	479.76	314.41	329.6	517.92	775.58	1006.98	1201.47	(97)
--------	---------	---------	---------	--------	--------	--------	--------	-------	--------	--------	---------	---------	------

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

(98)m=	492.95	371.02	296.01	157.2	67.9	0	0	0	0	167.5	339.03	504.76	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =												2396.37	(98)

Space heating requirement in kWh/m²/year

24.06	(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 93.2 (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)

492.95	371.02	296.01	157.2	67.9	0	0	0	0	167.5	339.03	504.76
--------	--------	--------	-------	------	---	---	---	---	-------	--------	--------

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

528.91	398.09	317.61	168.67	72.86	0	0	0	0	179.72	363.76	541.59
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) =Sum(211)_{1...5,10...12} = 2571.21 (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		
Total (kWh/year) =Sum(215) _{1...5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

188.28	165.41	172.44	152.79	148.42	130.76	123.83	138.31	138.85	158.54	169.86	183.15
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 87.3 (216)

DER WorkSheet: New dwelling design stage

(217)m=

89.38	89.29	89.11	88.75	88.19	87.3	87.3	87.3	87.3	88.77	89.21	89.41
-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------

 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=

210.65	185.26	193.51	172.16	168.3	149.78	141.84	158.43	159.05	178.6	190.41	204.85
--------	--------	--------	--------	-------	--------	--------	--------	--------	-------	--------	--------

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

2112.83

 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

kWh/year

Water heating fuel used

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

373.07

 (230a)

central heating pump:

30

 (230c)

boiler with a fan-assisted flue

45

 (230e)

Total electricity for the above, kWh/year

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

448.07

 (231)

Electricity for lighting

404.07

 (232)

Electricity generated by PVs

-509.54

 (233)

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	=	555.38	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	456.37	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1011.75	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	232.55	(267)
Electricity for lighting	(232) x	0.519	=	209.71	(268)
Energy saving/generation technologies Item 1		0.519	=	-264.45	(269)
Total CO2, kg/year	sum of (265)...(271) =			1189.57	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.94	(273)
EI rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr
Software Name: Stroma FSAP 2012

Stroma Number: STRO028460
Software Version: Version: 1.0.4.10

Property Address: B-G-03

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.71 (1a)	2.5 (2a)	174.27 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	174.27 (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			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.18 (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) =		0.15 (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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DER WorkSheet: New dwelling design stage

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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
------	------	------	------	------	------	------	------	------	------	------	------

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) =

68.85 (23c)

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

(24a)m= 0.35 0.34 0.34 0.32 0.32 0.3 0.3 0.29 0.3 0.32 0.32 0.33 (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= 0.35 0.34 0.34 0.32 0.32 0.3 0.3 0.29 0.3 0.32 0.32 0.33 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.9	x 1.2	= 2.28		(26)
Windows			17	x 1/[1/(1.2) + 0.04]	= 19.47		(27)
Floor			69.71	x 0.14	= 9.7594	110	7668.1 (28)
Walls Type1	42.49	17	25.49	x 0.18	= 4.59	60	1529.4 (29)
Walls Type2	42.49	1.9	40.59	x 0.17	= 6.78	60	2435.4 (29)
Total area of elements, m²			154.69				(31)
Party wall			40.78	x 0	= 0	110	4485.8 (32)
Party ceiling			69.71			30	2091.3 (32b)
Internal wall **			115.25			9	1037.25 (32c)

* 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) = 42.87 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 19247.25 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 276.1 (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 9 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 51.87 (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=	19.86	19.65	19.44	18.37	18.15	17.08	17.08	16.87	17.51	18.15	18.58	19.01

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

(39)m= 71.74 71.53 71.31 70.24 70.03 68.96 68.96 68.74 69.39 70.03 70.46 70.88 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.03	1.03	1.02	1.01	1	0.99	0.99	0.99	1	1	1.01	1.02		
Average = Sum(40) _{1...12} /12=													1.01	(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

2.24

(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

87.38

(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=	96.12	92.62	89.13	85.63	82.14	78.64	78.64	82.14	85.63	89.13	92.62	96.12		
Total = Sum(44) _{1...12} =													1048.53	(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=	142.54	124.66	128.64	112.15	107.61	92.86	86.05	98.74	99.92	116.45	127.12	138.04		
Total = Sum(45) _{1...12} =													1374.79	(45)

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

(46)m=	21.38	18.7	19.3	16.82	16.14	13.93	12.91	14.81	14.99	17.47	19.07	20.71		(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

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	23.57	21.26	23.47	22.65	23.36	22.55	23.27	23.33	22.61	23.43	22.75	23.55	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	
Output from water heater (annual) _{1...12}												1650.59	(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=	53.29	46.76	48.64	42.95	41.62	36.51	34.43	38.66	38.88	44.58	47.95	51.79	(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=	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	(66)

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

(67)m=	17.53	15.57	12.66	9.59	7.17	6.05	6.54	8.5	11.4	14.48	16.9	18.02	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	------	-------	------

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

(68)m=	196.62	198.66	193.52	182.57	168.76	155.77	147.09	145.05	150.2	161.14	174.96	187.94	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(69)m=	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	(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=	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	71.62	69.59	65.38	59.66	55.94	50.71	46.28	51.97	53.99	59.91	66.6	69.61	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(73)m=	345.36	343.4	331.14	311.4	291.45	272.12	259.49	265.1	275.18	295.12	318.04	335.15	(73)
--------	--------	-------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
East	0.9x	1	x	17	x	19.64	x	0.63	x	0.7	=	102.04	(76)
East	0.9x	1	x	17	x	38.42	x	0.63	x	0.7	=	199.61	(76)
East	0.9x	1	x	17	x	63.27	x	0.63	x	0.7	=	328.73	(76)
East	0.9x	1	x	17	x	92.28	x	0.63	x	0.7	=	479.43	(76)
East	0.9x	1	x	17	x	113.09	x	0.63	x	0.7	=	587.56	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	1	x	17	x	115.77	x	0.63	x	0.7	=	601.48	(76)
East	0.9x	1	x	17	x	110.22	x	0.63	x	0.7	=	572.63	(76)
East	0.9x	1	x	17	x	94.68	x	0.63	x	0.7	=	491.88	(76)
East	0.9x	1	x	17	x	73.59	x	0.63	x	0.7	=	382.33	(76)
East	0.9x	1	x	17	x	45.59	x	0.63	x	0.7	=	236.86	(76)
East	0.9x	1	x	17	x	24.49	x	0.63	x	0.7	=	127.23	(76)
East	0.9x	1	x	17	x	16.15	x	0.63	x	0.7	=	83.91	(76)

Solar gains in watts, calculated for each month

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

(83)m=	102.04	199.61	328.73	479.43	587.56	601.48	572.63	491.88	382.33	236.86	127.23	83.91	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	447.4	543.02	659.88	790.84	879.01	873.6	832.12	756.99	657.51	531.98	445.28	419.06	(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	0.97	0.89	0.71	0.5	0.36	0.42	0.7	0.96	1	1	(86)

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

(87)m=	20.05	20.22	20.5	20.81	20.96	21	21	21	20.97	20.72	20.32	20.02	(87)
--------	-------	-------	------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.06	20.06	20.06	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	1	0.99	0.97	0.86	0.65	0.43	0.29	0.34	0.62	0.93	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(90)m=	18.79	19.05	19.45	19.87	20.05	20.09	20.09	20.09	20.07	19.77	19.19	18.75	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.43 (91)

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

(92)m=	19.33	19.55	19.9	20.28	20.44	20.48	20.48	20.48	20.46	20.18	19.68	19.3	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

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

(93)m=	19.33	19.55	19.9	20.28	20.44	20.48	20.48	20.48	20.46	20.18	19.68	19.3	(93)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.96	0.86	0.67	0.46	0.32	0.37	0.65	0.94	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	446.02	537.84	635.94	682.56	589.8	403.52	267.54	280.32	427.85	498.7	441.82	418.17	(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 = [(93)m – (96)m]

(97)m=	1078.05	1047.95	955.72	799.14	612	405.43	267.71	280.7	441.16	670.67	886.09	1070.03	(97)
--------	---------	---------	--------	--------	-----	--------	--------	-------	--------	--------	--------	---------	------

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

(98)m=	470.23	342.79	237.92	83.94	16.52	0	0	0	0	127.94	319.87	484.99	
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DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 2084.19 (98)

Space heating requirement in kWh/m²/year 29.9 (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 92.9 (206)

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

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

Space heating requirement (calculated above)

470.23	342.79	237.92	83.94	16.52	0	0	0	0	127.94	319.87	484.99
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

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

506.17	368.99	256.1	90.35	17.78	0	0	0	0	137.72	344.31	522.06
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 2243.48 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59
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Efficiency of water heater 87.3 (216)

(217)m= 89.21 89.11 88.87 88.28 87.58 87.3 87.3 87.3 87.3 88.52 89.05 89.24 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=

186.21	163.76	171.17	152.7	149.54	132.2	125.22	139.83	140.35	158.01	168.28	181.09
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Total = Sum(219a)_{1...12} = 1868.37 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 2243.48 kWh/year

Water heating fuel used 1868.37 kWh/year

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 207.3 (230a)

central heating pump: 30 (230c)

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

Total electricity for the above, kWh/year sum of (230a)...(230g) = 282.3 (231)

Electricity for lighting 309.56 (232)

Electricity generated by PVs -509.54 (233)

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

DER 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	=	484.59 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	403.57 (264)
Space and water heating	(261) + (262) + (263) + (264) =			888.16 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	146.51 (267)
Electricity for lighting	(232) x	0.519	=	160.66 (268)
Energy saving/generation technologies Item 1		0.519	=	-264.45 (269)
Total CO2, kg/year	sum of (265)...(271) =			930.89 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			13.35 (273)
El rating (section 14)				89 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: B-1-03

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.71 (1a) x	2.5 (2a) =	174.27 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	174.27 (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			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.18 (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) =		0.14 (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

0.17	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.15	0.16
------	------	------	------	------	------	------	------	------	------	------	------

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) =

68.85 (23c)

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

(24a)m= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (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= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.9	x 1.2	= 2.28		(26)
Windows			17	x 1/[1/(1.2)+0.04]	= 19.47		(27)
Walls Type1	42.49	17	25.49	x 0.18	= 4.59	60	1529.4 (29)
Walls Type2	42.49	1.9	40.59	x 0.17	= 6.78	60	2435.4 (29)
Total area of elements, m²			84.98				(31)
Party wall			40.78	x 0	= 0	110	4485.8 (32)
Party floor			69.71			40	2788.4 (32a)
Party ceiling			69.71			30	2091.3 (32b)
Internal wall **			115.25			9	1037.25 (32c)

* 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) = 33.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14367.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 206.1 (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 7.5 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 40.62 (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=	18.9	18.71	18.51	17.54	17.34	16.37	16.37	16.17	16.76	17.34	17.73	18.12

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

(39)m= 59.52 59.32 59.13 58.15 57.96 56.98 56.98 56.79 57.37 57.96 58.35 58.74 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.84	0.84		
Average = Sum(40) _{1...12} /12=													0.83	(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

2.24

(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

87.38

(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 Vd,m = factor from Table 1c x (43)

(44)m=	96.12	92.62	89.13	85.63	82.14	78.64	78.64	82.14	85.63	89.13	92.62	96.12		
Total = Sum(44) _{1...12} =													1048.53	(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=	142.54	124.66	128.64	112.15	107.61	92.86	86.05	98.74	99.92	116.45	127.12	138.04		
Total = Sum(45) _{1...12} =													1374.79	(45)

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

(46)m=	21.38	18.7	19.3	16.82	16.14	13.93	12.91	14.81	14.99	17.47	19.07	20.71		(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

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
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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=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	23.57	21.26	23.47	22.65	23.36	22.55	23.27	23.33	22.61	23.43	22.75	23.55	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	
Output from water heater (annual) _{1...12}												1650.59	(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=	53.29	46.76	48.64	42.95	41.62	36.51	34.43	38.66	38.88	44.58	47.95	51.79	(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=	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	(66)

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

(67)m=	17.53	15.57	12.66	9.59	7.17	6.05	6.54	8.5	11.4	14.48	16.9	18.02	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	196.62	198.66	193.52	182.57	168.76	155.77	147.09	145.05	150.2	161.14	174.96	187.94	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	(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=	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	(71)
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Water heating gains (Table 5)

(72)m=	71.62	69.59	65.38	59.66	55.94	50.71	46.28	51.97	53.99	59.91	66.6	69.61	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(73)m=	345.36	343.4	331.14	311.4	291.45	272.12	259.49	265.1	275.18	295.12	318.04	335.15	(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_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	17	x	19.64	x	0.63	x	0.7	=	102.04 (76)
East	0.9x	1	x	17	x	38.42	x	0.63	x	0.7	=	199.61 (76)
East	0.9x	1	x	17	x	63.27	x	0.63	x	0.7	=	328.73 (76)
East	0.9x	1	x	17	x	92.28	x	0.63	x	0.7	=	479.43 (76)
East	0.9x	1	x	17	x	113.09	x	0.63	x	0.7	=	587.56 (76)

DER WorkSheet: New dwelling design stage

East	0.9x	1	x	17	x	115.77	x	0.63	x	0.7	=	601.48	(76)
East	0.9x	1	x	17	x	110.22	x	0.63	x	0.7	=	572.63	(76)
East	0.9x	1	x	17	x	94.68	x	0.63	x	0.7	=	491.88	(76)
East	0.9x	1	x	17	x	73.59	x	0.63	x	0.7	=	382.33	(76)
East	0.9x	1	x	17	x	45.59	x	0.63	x	0.7	=	236.86	(76)
East	0.9x	1	x	17	x	24.49	x	0.63	x	0.7	=	127.23	(76)
East	0.9x	1	x	17	x	16.15	x	0.63	x	0.7	=	83.91	(76)

Solar gains in watts, calculated for each month

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

(83)m=	102.04	199.61	328.73	479.43	587.56	601.48	572.63	491.88	382.33	236.86	127.23	83.91	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	447.4	543.02	659.88	790.84	879.01	873.6	832.12	756.99	657.51	531.98	445.28	419.06	(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	0.93	0.79	0.6	0.42	0.3	0.34	0.59	0.9	0.98	0.99	(86)

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

(87)m=	20.08	20.29	20.6	20.87	20.98	21	21	21	20.98	20.79	20.38	20.05	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.21	20.21	20.21	20.22	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.92	0.76	0.55	0.37	0.25	0.29	0.53	0.87	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.98	19.28	19.71	20.08	20.2	20.24	20.24	20.24	20.22	19.99	19.41	18.93	(90)
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fLA = Living area ÷ (4) =

0.43 (91)

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

(92)m=	19.45	19.72	20.09	20.42	20.54	20.56	20.57	20.57	20.55	20.33	19.83	19.41	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.45	19.72	20.09	20.42	20.54	20.56	20.57	20.57	20.55	20.33	19.83	19.41	(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	0.92	0.77	0.57	0.39	0.27	0.31	0.55	0.87	0.98	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	442.47	527.55	604.6	608.91	501.41	338.86	225.88	236.41	363.56	463.88	434.52	415.66	(95)
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Monthly average external temperature from Table 8

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

(97)m=	901.85	879.04	803.67	670.15	512.15	339.84	225.98	236.63	370.03	564.12	742.56	893.48	(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=	341.77	236.2	148.11	44.09	7.99	0	0	0	0	74.57	221.79	355.5	
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DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1430.02 (98)

Space heating requirement in kWh/m²/year 20.51 (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 92.9 (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)

341.77	236.2	148.11	44.09	7.99	0	0	0	0	74.57	221.79	355.5
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(211)m = {[(98)m × (204)] } × 100 ÷ (206) (211)

367.89	254.25	159.42	47.46	8.6	0	0	0	0	80.27	238.74	382.67
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 1539.32 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59
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Efficiency of water heater 87.3 (216)

(217)m= 89.03 88.89 88.56 87.93 87.45 87.3 87.3 87.3 87.3 88.19 88.83 89.07 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=

186.57	164.16	171.76	153.31	149.78	132.2	125.22	139.83	140.35	158.62	168.7	181.42
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Total = Sum(219a)_{1...12} = 1871.93 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year kWh/year

1539.32

Water heating fuel used

1871.93

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

207.3 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 282.3 (231)

Electricity for lighting

309.56 (232)

Electricity generated by PVs

-509.54 (233)

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

DER 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	=	332.49	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	404.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			736.83	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	146.51	(267)
Electricity for lighting	(232) x	0.519	=	160.66	(268)
Energy saving/generation technologies Item 1		0.519	=	-264.45	(269)
Total CO2, kg/year	sum of (265)...(271) =			779.56	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.18	(273)
El rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: B-2-03

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	69.71 (1a)	2.5 (2a)	174.27 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	69.71 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	174.27 (5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction <i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			0 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.18 (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) =		0.14 (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

0.17	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.15	0.16
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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) =

68.85 (23c)

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

(24a)m= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (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= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.9	x 1.2	= 2.28		(26)
Windows			17	x 1/[1/(1.2)+0.04]	= 19.47		(27)
Walls Type1	42.49	17	25.49	x 0.18	= 4.59	60	1529.4 (29)
Walls Type2	42.49	1.9	40.59	x 0.17	= 6.78	60	2435.4 (29)
Total area of elements, m²			84.98				(31)
Party wall			40.78	x 0	= 0	110	4485.8 (32)
Party floor			69.71			40	2788.4 (32a)
Party ceiling			69.71			30	2091.3 (32b)
Internal wall **			115.25			9	1037.25 (32c)

* 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) = 33.12 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 14367.55 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 206.1 (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 7.5 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 40.62 (37)

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

(38)m= 18.9 18.71 18.51 17.54 17.34 16.37 16.37 16.17 16.76 17.34 17.73 18.12 (38)

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

(39)m= 59.52 59.32 59.13 58.15 57.96 56.98 56.98 56.79 57.37 57.96 58.35 58.74

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	0.85	0.85	0.85	0.83	0.83	0.82	0.82	0.81	0.82	0.83	0.84	0.84		
	Average = Sum(40) _{1...12} /12=												0.83	(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

2.24

(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

87.38

(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 Vd,m = factor from Table 1c x (43)

(44)m=	96.12	92.62	89.13	85.63	82.14	78.64	78.64	82.14	85.63	89.13	92.62	96.12		
	Total = Sum(44) _{1...12} =												1048.53	(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=	142.54	124.66	128.64	112.15	107.61	92.86	86.05	98.74	99.92	116.45	127.12	138.04		
	Total = Sum(45) _{1...12} =												1374.79	(45)

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

(46)m=	21.38	18.7	19.3	16.82	16.14	13.93	12.91	14.81	14.99	17.47	19.07	20.71		(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

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	23.57	21.26	23.47	22.65	23.36	22.55	23.27	23.33	22.61	23.43	22.75	23.55	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	(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=	166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59	
Output from water heater (annual) _{1...12}												1650.59	(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=	53.29	46.76	48.64	42.95	41.62	36.51	34.43	38.66	38.88	44.58	47.95	51.79	(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=	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	111.95	(66)

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

(67)m=	17.53	15.57	12.66	9.59	7.17	6.05	6.54	8.5	11.4	14.48	16.9	18.02	(67)
--------	-------	-------	-------	------	------	------	------	-----	------	-------	------	-------	------

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

(68)m=	196.62	198.66	193.52	182.57	168.76	155.77	147.09	145.05	150.2	161.14	174.96	187.94	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(69)m=	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	(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=	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	-89.56	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	71.62	69.59	65.38	59.66	55.94	50.71	46.28	51.97	53.99	59.91	66.6	69.61	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	------

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

(73)m=	345.36	343.4	331.14	311.4	291.45	272.12	259.49	265.1	275.18	295.12	318.04	335.15	(73)
--------	--------	-------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	17	x	19.64	x	0.63	x	0.7	=	102.04 (76)
East	0.9x	1	x	17	x	38.42	x	0.63	x	0.7	=	199.61 (76)
East	0.9x	1	x	17	x	63.27	x	0.63	x	0.7	=	328.73 (76)
East	0.9x	1	x	17	x	92.28	x	0.63	x	0.7	=	479.43 (76)
East	0.9x	1	x	17	x	113.09	x	0.63	x	0.7	=	587.56 (76)

DER WorkSheet: New dwelling design stage

East	0.9x	1	x	17	x	115.77	x	0.63	x	0.7	=	601.48	(76)
East	0.9x	1	x	17	x	110.22	x	0.63	x	0.7	=	572.63	(76)
East	0.9x	1	x	17	x	94.68	x	0.63	x	0.7	=	491.88	(76)
East	0.9x	1	x	17	x	73.59	x	0.63	x	0.7	=	382.33	(76)
East	0.9x	1	x	17	x	45.59	x	0.63	x	0.7	=	236.86	(76)
East	0.9x	1	x	17	x	24.49	x	0.63	x	0.7	=	127.23	(76)
East	0.9x	1	x	17	x	16.15	x	0.63	x	0.7	=	83.91	(76)

Solar gains in watts, calculated for each month

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

(83)m=	102.04	199.61	328.73	479.43	587.56	601.48	572.63	491.88	382.33	236.86	127.23	83.91	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	447.4	543.02	659.88	790.84	879.01	873.6	832.12	756.99	657.51	531.98	445.28	419.06	(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	0.98	0.93	0.79	0.6	0.42	0.3	0.34	0.59	0.9	0.98	0.99	(86)

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

(87)m=	20.08	20.29	20.6	20.87	20.98	21	21	21	20.98	20.79	20.38	20.05	(87)
--------	-------	-------	------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

(88)m=	20.21	20.21	20.21	20.22	20.23	20.24	20.24	20.24	20.23	20.23	20.22	20.22	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.92	0.76	0.55	0.37	0.25	0.29	0.53	0.87	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	18.98	19.28	19.71	20.08	20.2	20.24	20.24	20.24	20.22	19.99	19.41	18.93	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.43 (91)

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

(92)m=	19.45	19.72	20.09	20.42	20.54	20.56	20.57	20.57	20.55	20.33	19.83	19.41	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.45	19.72	20.09	20.42	20.54	20.56	20.57	20.57	20.55	20.33	19.83	19.41	(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	0.97	0.92	0.77	0.57	0.39	0.27	0.31	0.55	0.87	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(95)m=	442.47	527.55	604.6	608.91	501.41	338.86	225.88	236.41	363.56	463.88	434.52	415.66	(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=	901.85	879.04	803.67	670.15	512.15	339.84	225.98	236.63	370.03	564.12	742.56	893.48	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(98)m=	341.77	236.2	148.11	44.09	7.99	0	0	0	0	74.57	221.79	355.5	
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DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1430.02 (98)

Space heating requirement in kWh/m²/year 20.51 (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 92.9 (206)

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

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

Space heating requirement (calculated above)

341.77	236.2	148.11	44.09	7.99	0	0	0	0	74.57	221.79	355.5
--------	-------	--------	-------	------	---	---	---	---	-------	--------	-------

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

367.89	254.25	159.42	47.46	8.6	0	0	0	0	80.27	238.74	382.67
--------	--------	--------	-------	-----	---	---	---	---	-------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} = 1539.32 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

166.11	145.92	152.12	134.8	130.97	115.41	109.32	122.07	122.53	139.88	149.86	161.59
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 87.3 (216)

(217)m= 89.03 88.89 88.56 87.93 87.45 87.3 87.3 87.3 87.3 88.19 88.83 89.07 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=

186.57	164.16	171.76	153.31	149.78	132.2	125.22	139.83	140.35	158.62	168.7	181.42
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Total = Sum(219a)_{1...12} = 1871.93 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year kWh/year

1539.32

Water heating fuel used

1871.93

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

207.3 (230a)

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) = 282.3 (231)

Electricity for lighting

309.56 (232)

Electricity generated by PVs

-509.54 (233)

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

DER 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	=	332.49 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	404.34 (264)
Space and water heating	(261) + (262) + (263) + (264) =			736.83 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	146.51 (267)
Electricity for lighting	(232) x	0.519	=	160.66 (268)
Energy saving/generation technologies Item 1		0.519	=	-264.45 (269)
Total CO2, kg/year	sum of (265)...(271) =			779.56 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.18 (273)
El rating (section 14)				91 (274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: George Farr **Stroma Number:** STRO028460
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: B-3-03

Address :

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	55.02 (1a) x	2.5 (2a) =	137.55 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.02 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	137.55 (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			3.5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.18 (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) =		0.14 (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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DER WorkSheet: New dwelling design stage

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

0.17	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.15	0.16
------	------	------	------	------	------	------	------	------	------	------	------

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) =

68.85 (23c)

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

(24a)m= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (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= 0.33 0.33 0.32 0.3 0.3 0.28 0.28 0.28 0.29 0.3 0.31 0.32 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.9	x 1.2	= 2.28		(26)
Windows			28	x 1/[1/(1.2) + 0.04]	= 32.06		(27)
Walls Type1	42.49	28	14.49	x 0.18	= 2.61	60	869.4 (29)
Walls Type2	42.49	1.9	40.59	x 0.17	= 6.78	60	2435.4 (29)
Roof	55.02	0	55.02	x 0.12	= 6.6	9	495.18 (30)
Total area of elements, m²			140				(31)
Party wall			32.18	x 0	= 0	110	3539.8 (32)
Party floor			55.02			40	2200.8 (32a)
Internal wall **			63			9	567 (32c)

* 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) = 50.33 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 10107.58 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 183.71 (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 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 56.33 (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=	14.92	14.77	14.61	13.84	13.69	12.92	12.92	12.76	13.23	13.69	14	14.3

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

(39)m= 71.25 71.1 70.94 70.17 70.02 69.25 69.25 69.1 69.56 70.02 70.33 70.64 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.3	1.29	1.29	1.28	1.27	1.26	1.26	1.26	1.26	1.27	1.28	1.28		
Average = Sum(40) _{1...12} /12=													1.27	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

1.84

(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

77.85

(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=	85.64	82.52	79.41	76.29	73.18	70.07	70.07	73.18	76.29	79.41	82.52	85.64		
Total = Sum(44) _{1...12} =													934.21	(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=	127	111.07	114.62	99.93	95.88	82.74	76.67	87.98	89.03	103.75	113.26	122.99		
Total = Sum(45) _{1...12} =													1224.9	(45)

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

(46)m=	19.05	16.66	17.19	14.99	14.38	12.41	11.5	13.2	13.35	15.56	16.99	18.45		(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

$$(48) \times (49) =$$

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

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

0

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

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

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

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0		(57)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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=	0	0	0	0	0	0	0	0	0	0	0	0		(59)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	23.45	21.15	23.37	22.56	23.28	22.48	23.21	23.25	22.53	23.33	22.64	23.43	(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=	150.45	132.22	137.99	122.49	119.16	105.22	99.88	111.23	111.56	127.09	135.9	146.42	(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=	150.45	132.22	137.99	122.49	119.16	105.22	99.88	111.23	111.56	127.09	135.9	146.42	
Output from water heater (annual) _{1...12}												1499.6	(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=	48.09	42.22	43.95	38.87	37.7	33.13	31.29	35.07	35.23	40.33	43.32	46.75	(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=	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	(66)

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

(67)m=	14.29	12.69	10.32	7.81	5.84	4.93	5.33	6.92	9.29	11.8	13.77	14.68	(67)
--------	-------	-------	-------	------	------	------	------	------	------	------	-------	-------	------

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

(68)m=	160.24	161.9	157.71	148.79	137.53	126.95	119.88	118.21	122.4	131.32	142.58	153.17	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

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

(69)m=	32.19	32.19	32.19	32.19	32.19	32.19	32.19	32.19	32.19	32.19	32.19	32.19	(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=	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	-73.52	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	64.64	62.83	59.08	53.98	50.67	46.02	42.06	47.13	48.94	54.21	60.16	62.84	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	292.73	290.98	280.67	264.15	247.61	231.46	220.83	225.84	234.2	250.9	270.09	284.26	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	------

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	28	x	19.64	x	0.63	x	0.7	=	168.06	(76)
East	0.9x	1	x	28	x	38.42	x	0.63	x	0.7	=	328.77	(76)
East	0.9x	1	x	28	x	63.27	x	0.63	x	0.7	=	541.44	(76)
East	0.9x	1	x	28	x	92.28	x	0.63	x	0.7	=	789.66	(76)
East	0.9x	1	x	28	x	113.09	x	0.63	x	0.7	=	967.75	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	1	x	28	x	115.77	x	0.63	x	0.7	=	990.67	(76)
East	0.9x	1	x	28	x	110.22	x	0.63	x	0.7	=	943.16	(76)
East	0.9x	1	x	28	x	94.68	x	0.63	x	0.7	=	810.16	(76)
East	0.9x	1	x	28	x	73.59	x	0.63	x	0.7	=	629.72	(76)
East	0.9x	1	x	28	x	45.59	x	0.63	x	0.7	=	390.11	(76)
East	0.9x	1	x	28	x	24.49	x	0.63	x	0.7	=	209.56	(76)
East	0.9x	1	x	28	x	16.15	x	0.63	x	0.7	=	138.21	(76)

Solar gains in watts, calculated for each month

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

(83)m=	168.06	328.77	541.44	789.66	967.75	990.67	943.16	810.16	629.72	390.11	209.56	138.21	(86)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(84)m=	460.79	619.75	822.11	1053.81	1215.36	1222.13	1163.99	1036	863.92	641.02	479.65	422.47	(84)
--------	--------	--------	--------	---------	---------	---------	---------	------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.95	0.86	0.69	0.51	0.36	0.26	0.3	0.53	0.83	0.96	0.99	(86)

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

(87)m=	19.46	19.83	20.33	20.75	20.93	20.99	21	20.99	20.95	20.59	19.92	19.39	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(88)m=	19.84	19.85	19.85	19.86	19.86	19.87	19.87	19.88	19.87	19.86	19.86	19.85	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.98	0.94	0.84	0.65	0.45	0.3	0.19	0.23	0.45	0.79	0.95	0.98	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

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

(90)m=	17.83	18.37	19.05	19.6	19.8	19.86	19.87	19.87	19.83	19.43	18.5	17.73	(90)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------	-------	------

fLA = Living area ÷ (4) =

0.55 (91)

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

(92)m=	18.72	19.17	19.75	20.23	20.42	20.48	20.49	20.48	20.44	20.06	19.27	18.63	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.72	19.17	19.75	20.23	20.42	20.48	20.49	20.48	20.44	20.06	19.27	18.63	(93)
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8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.97	0.93	0.83	0.66	0.48	0.33	0.23	0.27	0.49	0.8	0.94	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	446.57	574.92	685.33	700.03	585.23	402.26	268.15	280.56	422.01	512.04	452.54	412.37	(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=	1027.26	1014.42	940.03	794.95	610.46	406.91	269.06	282.22	440.83	662.53	856.11	1019.57	(97)
--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

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

(98)m=	432.03	295.34	189.49	68.34	18.77	0	0	0	0	111.97	290.57	451.75	
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DER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1858.27 (98)

Space heating requirement in kWh/m²/year 33.77 (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 92.9 (206)

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

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

Space heating requirement (calculated above)

432.03	295.34	189.49	68.34	18.77	0	0	0	0	111.97	290.57	451.75
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

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

465.05	317.91	203.97	73.56	20.21	0	0	0	0	120.52	312.78	486.28
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} = 2000.29 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m × (201)] } × 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)

150.45	132.22	137.99	122.49	119.16	105.22	99.88	111.23	111.56	127.09	135.9	146.42
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Efficiency of water heater 87.3 (216)

(217)m= 89.21 89.08 88.79 88.21 87.64 87.3 87.3 87.3 87.3 88.5 89.05 89.25 (217)

Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=

168.63	148.43	155.42	138.86	135.96	120.53	114.4	127.41	127.79	143.6	152.6	164.06
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Total = Sum(219a)_{1...12} = 1697.69 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 2000.29

Water heating fuel used kWh/year 1697.69

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 163.62 (230a)

central heating pump: 30 (230c)

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

Total electricity for the above, kWh/year sum of (230a)...(230g) = 238.62 (231)

Electricity for lighting 252.28 (232)

Electricity generated by PVs -509.54 (233)

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

DER 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	=	432.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	366.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			798.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	123.84	(267)
Electricity for lighting	(232) x	0.519	=	130.93	(268)
Energy saving/generation technologies Item 1		0.519	=	-264.45	(269)
Total CO2, kg/year	sum of (265)...(271) =			789.09	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			14.34	(273)
El rating (section 14)				89	(274)