

Technical Addendum to Energy Strategy – 43 London Street, Reading

27th April 2020

- 1.1 This note serves as a technical addendum to the Energy Statement produced by Envision (P19528.RP001 Energy Strategy – 43 London Street, Reading), which was submitted to Reading Borough Council (RBC) in 2019 to support a planning application for:

“..the refurbishment and re-development of 43 and 43A London Street, Reading to consist of the part-demolition of the existing London Street facade and internal works to building alongside demolition of two storey building to rear to enable residential-led mixed-use development comprising 48 sqm community use (Class D1) and 21 no residential units (2 x studio, 7 x 1 bed, 9 x 2 two bed and 3 x 3 bed units) together with associated services enclosures, parking and landscaping.”

- 1.2 The original Energy Statement presented a strategy for the new-build dwellings that achieved a **23.72%** reduction in CO₂ emissions through the use of energy efficient design measures and an 8.4 kWp PV array.
- 1.3 Policy H5(c) of the Reading Borough Local Plan (adopted November 2019) requires that; “All major new-build residential development should be designed to achieve zero carbon homes¹.”
- 1.4 In order to demonstrate compliance with Policy H5(c) this note sets out:

1. The updated PV requirements to meet the minimum 35% CO₂ emission reduction target:
 - (a) A 15.18 kWp array is now proposed as detailed in Table 1.1.
2. The updated ‘Be-Green’ results and resultant site-wide emission reductions:
 - (a) The revised on-site carbon savings are 35.54% as detailed in Table 1.2.
3. The carbon offset payment to bring the savings up to 100%:
 - (a) The carbon offset payment is **£24,742.76** as detailed in Table 1.3.
4. Appendix 1 contains the updated ‘Be-Green’ SAP worksheets for the new-build dwellings.

- 1.5 All other aspects of the original Energy Statement submitted with the original planning application remain the same.

Revised PV Quantum

- 1.6 The low-carbon/renewable energy proposed for the development is a Photovoltaic (PV) array. The proposed PV will be mounted at the uppermost roof level, on the south facing slope of the Simms Court block and the flat roof of the eastern building block.

¹ This is clarified in the RBC Sustainable Design and Construction SPD as a 35% improvement in the dwelling emission rate over the 2013 Building Regulations plus a contribution of £1,800 per tonne towards carbon offsetting within Reading (calculated as £60 per tonne over a 30 year period).

- 1.7 The building design will provide service riser accommodation to allow the roof mounted inverter to be wired back to a distribution board and G59 intake meter arrangement. Included in the table below is a break-down of the PV:

Table 1.1 – PV Array Details

Area	PV Area	PV Peak Power (kWp)	PV Energy Generation (kWh.annum)
Simms Court & East Roof	80m ² (approx.)	15.18 kWp	12,200 kWh/annum ²

- 1.8 The energy assessment assumed 46 no. 300 Watt PV panels, each measuring 1690mm (l) x 1010mm (w).

Be Green Stage – Updated CO₂ Reductions for New-Build portion

- 1.9 The following tables and graphs represent the updated Green stage improvements for the development over the Target Emission Rate as detailed in the original Energy Statement:

Table 1.2 – Updated Green Stage CO₂ Reductions over Baseline

Unit	Total Floor Area (m ²)	DER	Total CO ₂ (kg.CO ₂ .yr)	Regulated Energy (kWh.yr)
M-GF-3B	93	15.26	1,419.18	6,321.22
F-GF-2B (North)	62	14.61	905.82	4,247.16
F-GF-2B (East)	79	13.37	1,056.23	4,795.03
F-GF-3B (East)	83	13.33	1,106.39	5,015.97
F-MF-1B (North)	110	9.01	991.10	5,467.42
F-MF-1B (East)	109	11.46	1,249.14	7,020.70
F-MF-2B (North)	129	9.25	1,193.25	6,129.96
F-MF-2B (East)	280	8.25	2,310.00	12,328.28
F-TF-1B (North)	111	14.33	1,590.63	7,466.58
F-TF-2B (North)	62	14.67	909.54	4,265.44
F-TF-3B (East)	73	13.90	1,014.70	5,035.78
		Total =	13,745.98	68,093.54
		Difference over Be-Lean	6212.99	12156.88
		% Difference	31.13%	15.15%
		Difference over Baseline	7578.93	22538.52
		% Difference	35.54%	24.87%

- 1.10 As detailed above, the 18 new-build apartments are expected to reduce CO₂ emissions by **35.54%** over the Part L1a baseline, therefore in compliance with the minimum performance requirements of Policy H5(c) of the Reading Borough Local Plan (adopted November 2019).

² The kWh/annum requirement is the figure to be passed through to PV manufacturers and suppliers.

Updated New-Build Residential Emissions & Carbon Offset Payment

- 1.11 The charts below detail the updated site-wide carbon dioxide emissions and final carbon offset payment:

Table 1.3 – Sitewide Emissions

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	21.32	0.00
After energy demand reduction	19.96	0.00
After heat network / CHP	n/a	n/a
After renewable energy	13.75	0.00
	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Savings from energy demand reduction	1.37	6.41%
Savings from heat network / CHP	n/a	n/a
Savings from renewable energy	6.21	29.13%
Cumulative on-site savings	7.58	35.54%
Annual Savings from off-set payment	13.75	
Cumulative savings for off-set payment (over 30 Years)	412.38	
Carbon offset Payment (£60 per tonne)	£ 24,742.76	

- 1.12 As detailed above the carbon offset payment required in order to bring the on-site carbon emission savings to 100% is **£24,742.76**.

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-GF-2B (East)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	79 (1a)	2.4 (2a)	189.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	189.6 (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]×0.1 =	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 × (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 × (19)] =		0.78 (20)
Infiltration rate incorporating shelter factor	(21) = (18) × (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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Windows Type 2			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 3			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 4			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Windows Type 5			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Floor			79	0.12	9.48		(28)
Walls	75.2	14.82	60.38	0.16	9.66		(29)
Total area of elements, m²			154.2				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 36.25 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 12916.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 23.13 (36)

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

Total fabric heat loss (33) + (36) = 59.38 (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=	18.44	18.22	18.01	16.95	16.74	15.68	15.68	15.47	16.1	16.74	17.16	17.59

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

(39)m= 77.82 77.6 77.39 76.33 76.12 75.06 75.06 74.85 75.48 76.12 76.54 76.97 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.99	0.98	0.98	0.97	0.96	0.95	0.95	0.95	0.96	0.96	0.97	0.97		
Average = Sum(40) _{1...12} /12=													0.97	(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

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

if TFA ≤ 13.9, N = 1

2.44 (42)

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

92.24 (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 × (43)														
(44)m=	101.46	97.77	94.08	90.39	86.7	83.01	83.01	86.7	90.39	94.08	97.77	101.46		
Total = Sum(44) _{1...12} =													1106.83	(44)

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

(45)m=	150.46	131.59	135.79	118.39	113.6	98.02	90.83	104.23	105.48	122.93	134.18	145.71		
Total = Sum(45) _{1...12} =													1451.23	(45)

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

(46)m=	22.57	19.74	20.37	17.76	17.04	14.7	13.63	15.64	15.82	18.44	20.13	21.86		(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) × (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) × (51) × (52) × (53) = 0 (54)

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

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

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0		(56)
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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)
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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)
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DER WorkSheet: New dwelling design stage

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

(61)m=	50.96	45	47.94	44.58	44.18	40.94	42.3	44.18	44.58	47.94	48.22	50.96	(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=	201.42	176.6	183.74	162.96	157.78	138.96	133.14	148.42	150.06	170.87	182.4	196.67	(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=	201.42	176.6	183.74	162.96	157.78	138.96	133.14	148.42	150.06	170.87	182.4	196.67	
Output from water heater (annual) _{1...12}												2003	(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=	62.77	55.01	57.14	50.51	48.82	42.83	40.78	45.7	46.22	52.86	56.67	61.19	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	122.18	(66)

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

(67)m=	20.29	18.02	14.65	11.09	8.29	7	7.56	9.83	13.2	16.76	19.56	20.85	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	217.34	219.59	213.91	201.81	186.54	172.18	162.59	160.34	166.02	178.12	193.39	207.75	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	35.22	(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=	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	-97.74	(71)
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Water heating gains (Table 5)

(72)m=	84.37	81.85	76.8	70.15	65.61	59.48	54.81	61.43	64.19	71.05	78.71	82.24	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	384.64	382.12	368.01	345.71	323.1	301.32	287.62	294.26	306.06	328.58	354.31	373.5	(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)	
Northeast 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.77	x	2.94	x	19.64	x	0.75	x	0.85	=	25.51	(76)
East	0.9x	0.77	x	2.94	x	38.42	x	0.75	x	0.85	=	49.9	(76)
East	0.9x	0.77	x	2.94	x	63.27	x	0.75	x	0.85	=	82.18	(76)
East	0.9x	0.77	x	2.94	x	92.28	x	0.75	x	0.85	=	119.86	(76)
East	0.9x	0.77	x	2.94	x	113.09	x	0.75	x	0.85	=	146.89	(76)
East	0.9x	0.77	x	2.94	x	115.77	x	0.75	x	0.85	=	150.37	(76)
East	0.9x	0.77	x	2.94	x	110.22	x	0.75	x	0.85	=	143.16	(76)
East	0.9x	0.77	x	2.94	x	94.68	x	0.75	x	0.85	=	122.97	(76)
East	0.9x	0.77	x	2.94	x	73.59	x	0.75	x	0.85	=	95.58	(76)
East	0.9x	0.77	x	2.94	x	45.59	x	0.75	x	0.85	=	59.21	(76)
East	0.9x	0.77	x	2.94	x	24.49	x	0.75	x	0.85	=	31.81	(76)
East	0.9x	0.77	x	2.94	x	16.15	x	0.75	x	0.85	=	20.98	(76)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.75	x	0.85	=	32.51	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.75	x	0.85	=	55.38	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.75	x	0.85	=	75.77	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.75	x	0.85	=	93.88	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.75	x	0.85	=	105.15	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.75	x	0.85	=	104.39	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.75	x	0.85	=	100.65	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.75	x	0.85	=	92.24	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.75	x	0.85	=	82.04	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.75	x	0.85	=	61.2	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.75	x	0.85	=	38.94	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.75	x	0.85	=	27.82	(77)
South	0.9x	0.54	x	2.94	x	46.75	x	0.75	x	0.85	=	42.59	(78)
South	0.9x	0.54	x	2.94	x	76.57	x	0.75	x	0.85	=	69.74	(78)
South	0.9x	0.54	x	2.94	x	97.53	x	0.75	x	0.85	=	88.84	(78)
South	0.9x	0.54	x	2.94	x	110.23	x	0.75	x	0.85	=	100.41	(78)
South	0.9x	0.54	x	2.94	x	114.87	x	0.75	x	0.85	=	104.63	(78)
South	0.9x	0.54	x	2.94	x	110.55	x	0.75	x	0.85	=	100.7	(78)
South	0.9x	0.54	x	2.94	x	108.01	x	0.75	x	0.85	=	98.39	(78)
South	0.9x	0.54	x	2.94	x	104.89	x	0.75	x	0.85	=	95.55	(78)
South	0.9x	0.54	x	2.94	x	101.89	x	0.75	x	0.85	=	92.81	(78)
South	0.9x	0.54	x	2.94	x	82.59	x	0.75	x	0.85	=	75.23	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.54	x	2.94	x	55.42	x	0.75	x	0.85	=	50.48	(78)
South	0.9x	0.54	x	2.94	x	40.4	x	0.75	x	0.85	=	36.8	(78)
West	0.9x	0.54	x	2.94	x	19.64	x	0.75	x	0.85	=	17.89	(80)
West	0.9x	0.54	x	2.94	x	38.42	x	0.75	x	0.85	=	35	(80)
West	0.9x	0.54	x	2.94	x	63.27	x	0.75	x	0.85	=	57.63	(80)
West	0.9x	0.54	x	2.94	x	92.28	x	0.75	x	0.85	=	84.06	(80)
West	0.9x	0.54	x	2.94	x	113.09	x	0.75	x	0.85	=	103.01	(80)
West	0.9x	0.54	x	2.94	x	115.77	x	0.75	x	0.85	=	105.45	(80)
West	0.9x	0.54	x	2.94	x	110.22	x	0.75	x	0.85	=	100.4	(80)
West	0.9x	0.54	x	2.94	x	94.68	x	0.75	x	0.85	=	86.24	(80)
West	0.9x	0.54	x	2.94	x	73.59	x	0.75	x	0.85	=	67.03	(80)
West	0.9x	0.54	x	2.94	x	45.59	x	0.75	x	0.85	=	41.53	(80)
West	0.9x	0.54	x	2.94	x	24.49	x	0.75	x	0.85	=	22.31	(80)
West	0.9x	0.54	x	2.94	x	16.15	x	0.75	x	0.85	=	14.71	(80)

Solar gains in watts, calculated for each month

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

(83)m=	128.47	230.31	340.99	458.25	540.41	546.96	523.08	461.16	382.01	261.97	156.08	108.45	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	513.11	612.43	709	803.96	863.5	848.28	810.7	755.42	688.07	590.55	510.39	481.95	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.9	0.76	0.56	0.41	0.45	0.71	0.95	0.99	1	(86)

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

(87)m=	20.03	20.21	20.47	20.76	20.93	20.99	21	21	20.96	20.71	20.31	20	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.11	20.11	20.13	20.13	20.13	20.12	20.11	20.11	20.1	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.96	0.88	0.7	0.49	0.33	0.37	0.64	0.92	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.81	19.07	19.44	19.84	20.05	20.12	20.12	20.13	20.09	19.79	19.23	18.77	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.21	19.44	19.78	20.14	20.34	20.41	20.41	20.41	20.38	20.1	19.58	19.17	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(93)m=	19.06	19.29	19.63	19.99	20.19	20.26	20.26	20.26	20.23	19.95	19.43	19.02	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.96	0.87	0.71	0.5	0.34	0.38	0.65	0.92	0.99	1	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	510.22	603.34	679.02	702.61	611.29	420.87	274.57	288.52	446.79	543.15	503.58	479.98	(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=	1148.61	1117.02	1015.86	846.77	646.46	424.54	274.89	289.14	462.75	711.39	944.09	1140.95	(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=	474.96	345.19	250.61	103.79	26.17	0	0	0	0	125.17	317.17	491.76	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 2134.83 (98)

Space heating requirement in kWh/m²/year

27.02 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

474.96	345.19	250.61	103.79	26.17	0	0	0	0	125.17	317.17	491.76
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

524.82	381.43	276.92	114.69	28.92	0	0	0	0	138.31	350.47	543.38
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 2358.93 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

201.42	176.6	183.74	162.96	157.78	138.96	133.14	148.42	150.06	170.87	182.4	196.67
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Efficiency of water heater 81.2 (216)

(217)m= (217)

87.52	87.12	86.32	84.58	82.4	81.2	81.2	81.2	81.2	84.89	86.87	87.63
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	230.15	202.7	212.86	192.67	191.47	171.14	163.96	182.78	184.8	201.29	209.97	224.43	
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Total = Sum(219a)_{1...12} = 2368.21 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 2358.93 kWh/year

Water heating fuel used 2368.21

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 170.59 (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) =	245.59	(231)
Electricity for lighting		358.26	(232)
Electricity generated by PVs		-535.96	(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	=	509.53	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	511.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1021.06	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	127.46	(267)
Electricity for lighting	(232) x	0.519	=	185.94	(268)
Energy saving/generation technologies Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		1056.3	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.37	(273)
El rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-GF-2B (North)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61.8 (1a) x	2.4 (2a) =	148.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.32 (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
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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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 2			1.56	$\times 1/[1/(1.1) + 0.04]$	1.64		(27)
Windows Type 3			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 4			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 5			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Floor			61.8	0.12	7.416		(28)
Walls	63	19.32	43.68	0.16	6.99		(29)
Total area of elements, m²			124.8				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 36.25 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 9855.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.72 (36)

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

Total fabric heat loss (33) + (36) = 54.97 (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=	14.42	14.26	14.09	13.26	13.1	12.27	12.27	12.1	12.6	13.1	13.43	13.76

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

(39)m= 69.4 69.23 69.06 68.24 68.07 67.24 67.24 67.07 67.57 68.07 68.4 68.73 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.12	1.12	1.12	1.1	1.1	1.09	1.09	1.09	1.09	1.1	1.11	1.11		
Average = Sum(40) _{1...12} /12=													1.1	(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

2.03

(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

82.46

(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=	90.71	87.41	84.11	80.81	77.51	74.21	74.21	77.51	80.81	84.11	87.41	90.71		
Total = Sum(44) _{1...12} =													989.53	(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=	134.52	117.65	121.4	105.84	101.56	87.64	81.21	93.19	94.3	109.9	119.96	130.27		
Total = Sum(45) _{1...12} =													1297.43	(45)

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

(46)m=	20.18	17.65	18.21	15.88	15.23	13.15	12.18	13.98	14.15	16.48	17.99	19.54		(46)
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Water storage loss:

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

0

(47)

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

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

Water storage loss:

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

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

(48) x (49) =

0

(50)

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

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

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

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

0

(54)

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

0

(55)

Water storage loss calculated for each month

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

(56)m=	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=	46.22	40.23	42.86	39.85	39.5	36.6	37.82	39.5	39.85	42.86	43.11	46.22	(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=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	(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=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	
Output from water heater (annual) _{1...12}												1792.06	(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=	56.28	49.18	51.08	45.16	43.64	38.29	36.46	40.86	41.32	47.26	50.66	54.87	(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=	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	(66)

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

(67)m=	15.82	14.05	11.43	8.65	6.47	5.46	5.9	7.67	10.29	13.07	15.25	16.26	(67)
--------	-------	-------	-------	------	------	------	-----	------	-------	-------	-------	-------	------

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

(68)m=	177.46	179.3	174.66	164.78	152.31	140.59	132.76	130.92	135.56	145.44	157.91	169.63	(68)
--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	(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=	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	75.65	73.18	68.66	62.72	58.66	53.18	49	54.92	57.39	63.52	70.37	73.75	(72)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(73)m=	325.41	323.02	311.23	292.63	273.92	255.71	244.14	249.99	259.72	278.51	300.01	316.13	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	5.88	x	10.63	x	0.75	x	0.85	=	27.62	(74)
North	0.9x	0.77	x	5.88	x	20.32	x	0.75	x	0.85	=	52.79	(74)
North	0.9x	0.77	x	5.88	x	34.53	x	0.75	x	0.85	=	89.7	(74)
North	0.9x	0.77	x	5.88	x	55.46	x	0.75	x	0.85	=	144.08	(74)
North	0.9x	0.77	x	5.88	x	74.72	x	0.75	x	0.85	=	194.09	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.88	x	79.99	x	0.75	x	0.85	=	207.78	(74)
North	0.9x	0.77	x	5.88	x	74.68	x	0.75	x	0.85	=	193.99	(74)
North	0.9x	0.77	x	5.88	x	59.25	x	0.75	x	0.85	=	153.9	(74)
North	0.9x	0.77	x	5.88	x	41.52	x	0.75	x	0.85	=	107.85	(74)
North	0.9x	0.77	x	5.88	x	24.19	x	0.75	x	0.85	=	62.84	(74)
North	0.9x	0.77	x	5.88	x	13.12	x	0.75	x	0.85	=	34.08	(74)
North	0.9x	0.77	x	5.88	x	8.86	x	0.75	x	0.85	=	23.03	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.54	x	5.88	x	19.64	x	0.75	x	0.85	=	35.78	(76)
East	0.9x	0.54	x	5.88	x	38.42	x	0.75	x	0.85	=	69.99	(76)
East	0.9x	0.54	x	5.88	x	63.27	x	0.75	x	0.85	=	115.27	(76)
East	0.9x	0.54	x	5.88	x	92.28	x	0.75	x	0.85	=	168.11	(76)
East	0.9x	0.54	x	5.88	x	113.09	x	0.75	x	0.85	=	206.03	(76)
East	0.9x	0.54	x	5.88	x	115.77	x	0.75	x	0.85	=	210.91	(76)
East	0.9x	0.54	x	5.88	x	110.22	x	0.75	x	0.85	=	200.79	(76)
East	0.9x	0.54	x	5.88	x	94.68	x	0.75	x	0.85	=	172.48	(76)
East	0.9x	0.54	x	5.88	x	73.59	x	0.75	x	0.85	=	134.06	(76)
East	0.9x	0.54	x	5.88	x	45.59	x	0.75	x	0.85	=	83.05	(76)
East	0.9x	0.54	x	5.88	x	24.49	x	0.75	x	0.85	=	44.61	(76)
East	0.9x	0.54	x	5.88	x	16.15	x	0.75	x	0.85	=	29.42	(76)
Southeast	0.9x	0.54	x	1.56	x	36.79	x	0.75	x	0.85	=	17.78	(77)
Southeast	0.9x	0.54	x	1.56	x	62.67	x	0.75	x	0.85	=	30.29	(77)
Southeast	0.9x	0.54	x	1.56	x	85.75	x	0.75	x	0.85	=	41.45	(77)
Southeast	0.9x	0.54	x	1.56	x	106.25	x	0.75	x	0.85	=	51.35	(77)
Southeast	0.9x	0.54	x	1.56	x	119.01	x	0.75	x	0.85	=	57.52	(77)
Southeast	0.9x	0.54	x	1.56	x	118.15	x	0.75	x	0.85	=	57.11	(77)
Southeast	0.9x	0.54	x	1.56	x	113.91	x	0.75	x	0.85	=	55.06	(77)
Southeast	0.9x	0.54	x	1.56	x	104.39	x	0.75	x	0.85	=	50.45	(77)
Southeast	0.9x	0.54	x	1.56	x	92.85	x	0.75	x	0.85	=	44.88	(77)
Southeast	0.9x	0.54	x	1.56	x	69.27	x	0.75	x	0.85	=	33.48	(77)

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.54	x	1.56	x	44.07	x	0.75	x	0.85	=	21.3	(77)
Southeast 0.9x	0.54	x	1.56	x	31.49	x	0.75	x	0.85	=	15.22	(77)
Northwest 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(81)
Northwest 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(81)
Northwest 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(81)
Northwest 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest 0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest 0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest 0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest 0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest 0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest 0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest 0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	101.12	193.66	319.54	483.64	619.06	647.88	610.83	505.18	375.89	228.97	125.08	83.95	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	426.54	516.67	630.77	776.27	892.98	903.6	854.97	755.17	635.61	507.48	425.09	400.08	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.86	0.67	0.47	0.35	0.41	0.69	0.94	0.99	1	(86)

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

(87)m=	19.88	20.08	20.4	20.76	20.95	20.99	21	21	20.96	20.65	20.19	19.84	(87)
--------	-------	-------	------	-------	-------	-------	----	----	-------	-------	-------	-------	------

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

(88)m=	19.98	19.98	19.99	20	20	20.01	20.01	20.01	20.01	20	20	19.99	(88)
--------	-------	-------	-------	----	----	-------	-------	-------	-------	----	----	-------	------

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

(89)m=	0.99	0.99	0.95	0.83	0.61	0.4	0.27	0.32	0.61	0.92	0.99	1	(89)
--------	------	------	------	------	------	-----	------	------	------	------	------	---	------

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

(90)m=	18.5	18.79	19.25	19.74	19.95	20.01	20.01	20.01	19.98	19.61	18.96	18.45	(90)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.42 (91)

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

(92)m=	19.07	19.32	19.72	20.16	20.37	20.42	20.42	20.42	20.38	20.04	19.47	19.03	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.92	19.17	19.57	20.01	20.22	20.27	20.27	20.27	20.23	19.89	19.32	18.88	(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	0.98	0.95	0.83	0.62	0.42	0.29	0.34	0.63	0.92	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	423.6	507.67	596.99	643.21	556.62	378.61	246.55	259.02	397.86	464.64	418.71	398.04	(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=	1014.63	988.15	902.96	758.38	579.67	380.97	246.81	259.64	414.37	632.41	835.82	1008.96	(97)
--------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

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

(98)m=	439.72	322.88	227.64	82.92	17.15	0	0	0	0	124.82	300.32	454.53	
--------	--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1969.98 (98)

Space heating requirement in kWh/m²/year

31.88 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

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

Space heating requirement (calculated above)

439.72	322.88	227.64	82.92	17.15	0	0	0	0	124.82	300.32	454.53
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

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

485.88	356.78	251.54	91.62	18.95	0	0	0	0	137.92	331.85	502.24
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1...5,10...12} = 2176.78 (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)

180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater 81.2 (216)

(217)m= (217)

87.58	87.22	86.35	84.34	82.11	81.2	81.2	81.2	81.2	85.13	86.99	87.69
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	206.38	181.02	190.22	172.74	171.78	153	146.59	163.41	165.21	179.43	187.45	201.27
---------	--------	--------	--------	--------	--------	-----	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2118.49 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

2176.78

Water heating fuel used

2118.49

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

133.45

(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) =	208.45	(231)
Electricity for lighting		279.4	(232)
Electricity generated by PVs		-535.96	(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	=	470.18	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	457.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			927.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	108.19	(267)
Electricity for lighting	(232) x	0.519	=	145.01	(268)
Energy saving/generation technologies Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		902.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.61	(273)
El rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-GF-3B (East)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	83.12 (1a) x	2.4 (2a) =	199.49 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.12 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	199.49 (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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			5.88	$\times 1/[1/(1.1)+0.04]$	6.2		(27)
Windows Type 2			2	$\times 1/[1/(1.1)+0.04]$	2.11		(27)
Windows Type 3			2	$\times 1/[1/(1.1)+0.04]$	2.11		(27)
Windows Type 4			5.145	$\times 1/[1/(1.1)+0.04]$	5.42		(27)
Floor			83.12	0.12	9.974401		(28)
Walls	74.25	17.03	57.22	0.16	9.16		(29)
Total area of elements, m²			157.37				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 38.56 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 13148.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 23.61 (36)

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

Total fabric heat loss (33) + (36) = 62.17 (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=	19.4	19.18	18.95	17.84	17.61	16.5	16.5	16.27	16.94	17.61	18.06	18.51

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

(39)m= 81.57 81.34 81.12 80 79.78 78.66 78.66 78.44 79.11 79.78 80.23 80.67
Average = Sum(39)_{1...12} /12= 79.95 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.94	0.95	0.96	0.97	0.97		
Average = Sum(40) _{1...12} /12=													0.96	(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

2.52

(42)

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

if TFA ≤ 13.9, N = 1

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

94.04

(43)

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

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

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

(44)m=	103.44	99.68	95.92	92.16	88.39	84.63	84.63	88.39	92.16	95.92	99.68	103.44		
Total = Sum(44) _{1...12} =													1128.43	(44)

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

(45)m=	153.4	134.16	138.44	120.7	115.81	99.94	92.61	106.27	107.54	125.32	136.8	148.56		
Total = Sum(45) _{1...12} =													1479.55	(45)

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

(46)m=	23.01	20.12	20.77	18.1	17.37	14.99	13.89	15.94	16.13	18.8	20.52	22.28		(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) × (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) × (51) × (52) × (53) =

0

(54)

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

0

(55)

Water storage loss calculated for each month

((56)m = (55) × (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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	50.96	45.88	48.88	45.45	45.04	41.74	43.13	45.04	45.45	48.88	49.16	50.96	(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=	204.36	180.04	187.32	166.14	160.86	141.67	135.73	151.31	152.98	174.2	185.96	199.52	(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=	204.36	180.04	187.32	166.14	160.86	141.67	135.73	151.31	152.98	174.2	185.96	199.52	
Output from water heater (annual) _{1...12}												2040.1	(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=	63.74	56.08	58.25	51.49	49.77	43.66	41.57	46.6	47.12	53.89	57.78	62.14	(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=	125.97	125.97	125.97	125.97	125.97	125.97	125.97	125.97	125.97	125.97	125.97	125.97	(66)

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

(67)m=	20.57	18.27	14.86	11.25	8.41	7.1	7.67	9.97	13.39	17	19.84	21.15	(67)
--------	-------	-------	-------	-------	------	-----	------	------	-------	----	-------	-------	------

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

(68)m=	225.84	228.18	222.28	209.7	193.83	178.92	168.95	166.61	172.52	185.09	200.96	215.87	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.6	35.6	35.6	35.6	35.6	35.6	35.6	35.6	35.6	35.6	35.6	35.6	(69)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Pumps and fans gains (Table 5a)

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

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

(71)m=	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	-100.78	(71)
--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

(72)m=	85.68	83.45	78.3	71.52	66.89	60.64	55.88	62.63	65.44	72.43	80.24	83.51	(72)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	395.88	393.7	379.22	356.26	332.93	310.45	296.3	303	315.13	338.31	364.83	384.33	(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)	
Northeast 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)

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Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.77	x	5.88	x	19.64	x	0.75	x	0.85	=	51.02	(76)
East	0.9x	0.77	x	5.88	x	38.42	x	0.75	x	0.85	=	99.81	(76)
East	0.9x	0.77	x	5.88	x	63.27	x	0.75	x	0.85	=	164.37	(76)
East	0.9x	0.77	x	5.88	x	92.28	x	0.75	x	0.85	=	239.72	(76)
East	0.9x	0.77	x	5.88	x	113.09	x	0.75	x	0.85	=	293.78	(76)
East	0.9x	0.77	x	5.88	x	115.77	x	0.75	x	0.85	=	300.74	(76)
East	0.9x	0.77	x	5.88	x	110.22	x	0.75	x	0.85	=	286.32	(76)
East	0.9x	0.77	x	5.88	x	94.68	x	0.75	x	0.85	=	245.94	(76)
East	0.9x	0.77	x	5.88	x	73.59	x	0.75	x	0.85	=	191.16	(76)
East	0.9x	0.77	x	5.88	x	45.59	x	0.75	x	0.85	=	118.43	(76)
East	0.9x	0.77	x	5.88	x	24.49	x	0.75	x	0.85	=	63.62	(76)
East	0.9x	0.77	x	5.88	x	16.15	x	0.75	x	0.85	=	41.96	(76)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.75	x	0.85	=	32.51	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.75	x	0.85	=	55.38	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.75	x	0.85	=	75.77	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.75	x	0.85	=	93.88	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.75	x	0.85	=	105.15	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.75	x	0.85	=	104.39	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.75	x	0.85	=	100.65	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.75	x	0.85	=	92.24	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.75	x	0.85	=	82.04	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.75	x	0.85	=	61.2	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.75	x	0.85	=	38.94	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.75	x	0.85	=	27.82	(77)
West	0.9x	0.54	x	5.14	x	19.64	x	0.75	x	0.85	=	31.31	(80)
West	0.9x	0.54	x	5.14	x	38.42	x	0.75	x	0.85	=	61.24	(80)
West	0.9x	0.54	x	5.14	x	63.27	x	0.75	x	0.85	=	100.86	(80)
West	0.9x	0.54	x	5.14	x	92.28	x	0.75	x	0.85	=	147.1	(80)
West	0.9x	0.54	x	5.14	x	113.09	x	0.75	x	0.85	=	180.28	(80)
West	0.9x	0.54	x	5.14	x	115.77	x	0.75	x	0.85	=	184.54	(80)
West	0.9x	0.54	x	5.14	x	110.22	x	0.75	x	0.85	=	175.69	(80)
West	0.9x	0.54	x	5.14	x	94.68	x	0.75	x	0.85	=	150.92	(80)
West	0.9x	0.54	x	5.14	x	73.59	x	0.75	x	0.85	=	117.3	(80)
West	0.9x	0.54	x	5.14	x	45.59	x	0.75	x	0.85	=	72.67	(80)

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West	0.9x	0.54	x	5.14	x	24.49	x	0.75	x	0.85	=	39.04	(80)
West	0.9x	0.54	x	5.14	x	16.15	x	0.75	x	0.85	=	25.75	(80)

Solar gains in watts, calculated for each month

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

(83)m=	124.81	236.72	377.56	540.74	659.92	675.72	643.15	553.27	435.06	277.1	154.14	103.67	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	520.69	630.42	756.78	897.01	992.85	986.18	939.45	856.27	750.19	615.41	518.96	487.99	(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)
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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	0.88	0.71	0.51	0.37	0.42	0.69	0.95	0.99	1	(86)

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

(87)m=	20.02	20.2	20.48	20.79	20.95	20.99	21	21	20.97	20.71	20.3	19.99	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.1	20.1	20.1	20.11	20.12	20.13	20.13	20.13	20.12	20.12	20.11	20.11	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.96	0.85	0.65	0.44	0.3	0.34	0.62	0.93	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.78	19.05	19.46	19.89	20.08	20.12	20.13	20.13	20.1	19.79	19.21	18.75	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.42 (91)

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

(92)m=	19.3	19.54	19.89	20.27	20.45	20.49	20.49	20.5	20.47	20.18	19.67	19.27	(92)
--------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

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

(93)m=	19.15	19.39	19.74	20.12	20.3	20.34	20.34	20.35	20.32	20.03	19.52	19.12	(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	0.85	0.66	0.46	0.31	0.36	0.64	0.92	0.99	1	(94)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

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

(95)m=	518.31	622.16	723.75	765.56	659.02	449.14	294.37	309.01	476.77	568.81	513.22	486.4	(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=	1211.56	1178.47	1074.13	897.66	685.74	451.61	294.59	309.5	491.85	752.31	996.09	1203.45	(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=	515.78	373.84	260.68	95.11	19.88	0	0	0	0	136.53	347.67	533.48	
--------	--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 2282.97 (98)

Space heating requirement in kWh/m ² /year	27.47	(99)
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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system	0	(201)
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DER WorkSheet: New dwelling design stage

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		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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

Space heating requirement (calculated above)

515.78	373.84	260.68	95.11	19.88	0	0	0	0	136.53	347.67	533.48
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(211)m = {[[(98)m × (204)] } × 100 ÷ (206) (211)

569.93	413.08	288.05	105.09	21.97	0	0	0	0	150.86	384.16	589.49
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 2522.62 (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	Total (kWh/year) = Sum(215) _{1...5,10...12} = 0 (215)
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Water heating

Output from water heater (calculated above)

204.36	180.04	187.32	166.14	160.86	141.67	135.73	151.31	152.98	174.2	185.96	199.52
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Efficiency of water heater 81.2 (216)

(217)m=	87.65	87.25	86.36	84.36	82.13	81.2	81.2	81.2	81.2	85.04	87.03	87.76	(217)
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Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

(219)m=	233.15	206.35	216.9	196.96	195.86	174.48	167.16	186.35	188.4	204.85	213.68	227.33	Total = Sum(219a) _{1...12} = 2411.46 (219)
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Annual totals

	kWh/year	kWh/year
Space heating fuel used, main system 1		2522.62
Water heating fuel used		2411.46

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside	179.49	(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) = 254.49 (231)

Electricity for lighting 363.36 (232)

Electricity generated by PVs -535.96 (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) ×	0.216 =	544.89 (261)
Space heating (secondary)	(215) ×	0.519 =	0 (263)
Water heating	(219) ×	0.216 =	520.87 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1065.76 (265)

DER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	132.08	(267)
Electricity for lighting	(232) x	0.519	=	188.58	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		1108.26	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.33	(273)
EI rating (section 14)				88	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-MF-1B (East)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	58.44 (1a)	x	2.4 (2a)	=	140.26 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	58.44 (4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	140.26 (5)

2. Ventilation rate:

27 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 <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
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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

0.19	0.19	0.18	0.16	0.16	0.14	0.14	0.14	0.15	0.16	0.17	0.17
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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) =

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (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= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Windows Type 2			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 3			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 4			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Windows Type 5			6.72	$\times 1/[1/(1.1) + 0.04]$	7.08		(27)
Walls	75	18.6	56.4	0.16	9.02		(29)
Roof	24.91	0	24.91	0.11	2.74		(30)
Total area of elements, m²			99.91				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 32.85 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 4172.19 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 14.99 (36)

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

Total fabric heat loss (33) + (36) = 47.84 (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=	13.82	13.65	13.48	12.62	12.45	11.59	11.59	11.41	11.93	12.45	12.79	13.13

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

(39)m= 61.66 61.49 61.32 60.46 60.29 59.43 59.43 59.25 59.77 60.29 60.63 60.98 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

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

(40)m=	1.06	1.05	1.05	1.03	1.03	1.02	1.02	1.01	1.02	1.03	1.04	1.04		
Average = Sum(40) _{1...12} /12=													1.03	(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

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

$$\text{if TFA} \leq 13.9, N = 1$$

1.94 (42)

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

80.21 (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 $V_{d,m}$ = factor from Table 1c x (43)														
(44)m=	88.23	85.02	81.81	78.6	75.4	72.19	72.19	75.4	78.6	81.81	85.02	88.23		
Total = Sum(44) _{1...12} =													962.5	(44)

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

(45)m=	130.84	114.43	118.09	102.95	98.78	85.24	78.99	90.64	91.72	106.9	116.69	126.71		
Total = Sum(45) _{1...12} =													1261.99	(45)

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

(46)m=	19.63	17.17	17.71	15.44	14.82	12.79	11.85	13.6	13.76	16.03	17.5	19.01		(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)
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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	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 × (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)
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DER WorkSheet: New dwelling design stage

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

(61)m=	44.96	39.13	41.69	38.76	38.42	35.6	36.79	38.42	38.76	41.69	41.93	44.96	(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=	175.8	153.57	159.78	141.71	137.2	120.84	115.78	129.06	130.49	148.59	158.61	171.67	(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=	175.8	153.57	159.78	141.71	137.2	120.84	115.78	129.06	130.49	148.59	158.61	171.67	
Output from water heater (annual) _{1...12}												1743.11	(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=	54.75	47.83	49.69	43.92	42.45	37.24	35.46	39.74	40.19	45.97	49.28	53.37	(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=	96.86	96.86	96.86	96.86	96.86	96.86	96.86	96.86	96.86	96.86	96.86	96.86	(66)

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

(67)m=	15.07	13.38	10.88	8.24	6.16	5.2	5.62	7.3	9.8	12.45	14.53	15.48	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	169	170.75	166.33	156.92	145.05	133.89	126.43	124.68	129.09	138.5	150.38	161.54	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	32.69	(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=	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	-77.49	(71)
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Water heating gains (Table 5)

(72)m=	73.58	71.18	66.78	61	57.06	51.73	47.66	53.42	55.82	61.78	68.44	71.74	(72)
--------	-------	-------	-------	----	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	312.7	310.37	299.05	281.22	263.32	245.87	234.77	240.46	249.77	267.79	288.41	303.82	(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)	
North	0.9x	0.77	x	6.72	x	10.63	x	0.75	x	0.85	=	31.57 (74)
North	0.9x	0.77	x	6.72	x	20.32	x	0.75	x	0.85	=	60.33 (74)
North	0.9x	0.77	x	6.72	x	34.53	x	0.75	x	0.85	=	102.51 (74)
North	0.9x	0.77	x	6.72	x	55.46	x	0.75	x	0.85	=	164.66 (74)
North	0.9x	0.77	x	6.72	x	74.72	x	0.75	x	0.85	=	221.82 (74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	6.72	x	79.99	x	0.75	x	0.85	=	237.46	(74)
North	0.9x	0.77	x	6.72	x	74.68	x	0.75	x	0.85	=	221.7	(74)
North	0.9x	0.77	x	6.72	x	59.25	x	0.75	x	0.85	=	175.89	(74)
North	0.9x	0.77	x	6.72	x	41.52	x	0.75	x	0.85	=	123.25	(74)
North	0.9x	0.77	x	6.72	x	24.19	x	0.75	x	0.85	=	71.81	(74)
North	0.9x	0.77	x	6.72	x	13.12	x	0.75	x	0.85	=	38.94	(74)
North	0.9x	0.77	x	6.72	x	8.86	x	0.75	x	0.85	=	26.32	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.77	x	2.94	x	19.64	x	0.75	x	0.85	=	25.51	(76)
East	0.9x	0.77	x	2.94	x	38.42	x	0.75	x	0.85	=	49.9	(76)
East	0.9x	0.77	x	2.94	x	63.27	x	0.75	x	0.85	=	82.18	(76)
East	0.9x	0.77	x	2.94	x	92.28	x	0.75	x	0.85	=	119.86	(76)
East	0.9x	0.77	x	2.94	x	113.09	x	0.75	x	0.85	=	146.89	(76)
East	0.9x	0.77	x	2.94	x	115.77	x	0.75	x	0.85	=	150.37	(76)
East	0.9x	0.77	x	2.94	x	110.22	x	0.75	x	0.85	=	143.16	(76)
East	0.9x	0.77	x	2.94	x	94.68	x	0.75	x	0.85	=	122.97	(76)
East	0.9x	0.77	x	2.94	x	73.59	x	0.75	x	0.85	=	95.58	(76)
East	0.9x	0.77	x	2.94	x	45.59	x	0.75	x	0.85	=	59.21	(76)
East	0.9x	0.77	x	2.94	x	24.49	x	0.75	x	0.85	=	31.81	(76)
East	0.9x	0.77	x	2.94	x	16.15	x	0.75	x	0.85	=	20.98	(76)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.75	x	0.85	=	32.51	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.75	x	0.85	=	55.38	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.75	x	0.85	=	75.77	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.75	x	0.85	=	93.88	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.75	x	0.85	=	105.15	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.75	x	0.85	=	104.39	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.75	x	0.85	=	100.65	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.75	x	0.85	=	92.24	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.75	x	0.85	=	82.04	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.75	x	0.85	=	61.2	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	2	x	44.07	x	0.75	x	0.85	=	38.94	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.75	x	0.85	=	27.82	(77)
West	0.9x	0.54	x	2.94	x	19.64	x	0.75	x	0.85	=	17.89	(80)
West	0.9x	0.54	x	2.94	x	38.42	x	0.75	x	0.85	=	35	(80)
West	0.9x	0.54	x	2.94	x	63.27	x	0.75	x	0.85	=	57.63	(80)
West	0.9x	0.54	x	2.94	x	92.28	x	0.75	x	0.85	=	84.06	(80)
West	0.9x	0.54	x	2.94	x	113.09	x	0.75	x	0.85	=	103.01	(80)
West	0.9x	0.54	x	2.94	x	115.77	x	0.75	x	0.85	=	105.45	(80)
West	0.9x	0.54	x	2.94	x	110.22	x	0.75	x	0.85	=	100.4	(80)
West	0.9x	0.54	x	2.94	x	94.68	x	0.75	x	0.85	=	86.24	(80)
West	0.9x	0.54	x	2.94	x	73.59	x	0.75	x	0.85	=	67.03	(80)
West	0.9x	0.54	x	2.94	x	45.59	x	0.75	x	0.85	=	41.53	(80)
West	0.9x	0.54	x	2.94	x	24.49	x	0.75	x	0.85	=	22.31	(80)
West	0.9x	0.54	x	2.94	x	16.15	x	0.75	x	0.85	=	14.71	(80)

Solar gains in watts, calculated for each month

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

(83)m=	117.45	220.9	354.66	522.5	657.59	683.73	646.4	541.51	412.46	258.56	144.54	97.97	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	430.15	531.27	653.72	803.73	920.91	929.59	881.16	781.96	662.23	526.34	432.95	401.79	(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	0.94	0.8	0.59	0.41	0.3	0.35	0.6	0.91	0.99	1	(86)

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

(87)m=	20.02	20.24	20.55	20.86	20.98	21	21	21	20.98	20.76	20.32	19.98	(87)
--------	-------	-------	-------	-------	-------	----	----	----	-------	-------	-------	-------	------

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

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

(89)m=	0.99	0.98	0.93	0.76	0.54	0.35	0.23	0.28	0.53	0.88	0.98	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.74	19.05	19.5	19.91	20.04	20.07	20.07	20.07	20.05	19.8	19.19	18.69	(90)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.58 (91)

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

(92)m=	19.48	19.74	20.11	20.46	20.58	20.61	20.61	20.61	20.59	20.35	19.84	19.43	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.33	19.59	19.96	20.31	20.43	20.46	20.46	20.46	20.44	20.2	19.69	19.28	(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	0.98	0.92	0.77	0.56	0.37	0.26	0.31	0.56	0.88	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	426.43	518.37	604.09	622.35	515.53	347.04	229.13	240.22	371.26	464.81	424.27	399.27	(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=	926.58	903.17	825.34	689.7	526.28	347.97	229.23	240.46	378.87	578.86	763.43	919.72	(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=	372.11	258.58	164.61	48.49	8	0	0	0	0	84.86	244.2	387.21	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1568.06 (98)

Space heating requirement in kWh/m²/year

26.83 (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 90.5 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

372.11	258.58	164.61	48.49	8	0	0	0	0	84.86	244.2	387.21
--------	--------	--------	-------	---	---	---	---	---	-------	-------	--------

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

411.17	285.72	181.89	53.58	8.84	0	0	0	0	93.76	269.83	427.86
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 1732.66 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] } x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

175.8	153.57	159.78	141.71	137.2	120.84	115.78	129.06	130.49	148.59	158.61	171.67
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Efficiency of water heater 81.2 (216)

(217)m= (217)

87.29	86.8	85.67	83.38	81.66	81.2	81.2	81.2	81.2	84.35	86.59	87.42
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	201.4	176.93	186.51	169.95	168.01	148.82	142.58	158.94	160.7	176.15	183.17	196.37	
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Total = Sum(219a)_{1...12} = 2069.54 (219)

Annual totals

Space heating fuel used, main system 1 kWh/year 1732.66 kWh/year

Water heating fuel used 2069.54

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 154 (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) =	229	(231)
Electricity for lighting		266.07	(232)
Electricity generated by PVs		-786.92	(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	=	374.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	447.02	(264)
Space and water heating	(261) + (262) + (263) + (264) =			821.28	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	118.85	(267)
Electricity for lighting	(232) x	0.519	=	138.09	(268)
Energy saving/generation technologies Item 1		0.519	=	-408.41	(269)
Total CO2, kg/year		sum of (265)...(271) =		669.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.46	(273)
El rating (section 14)				91	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-MF-1B (North)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	54.9 (1a)	2.4 (2a)	131.76 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.9 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.76 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				0 x 10 =	0 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

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

78.2 (23c)

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

(24a)m= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (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= 0.3 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.28 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			5.88	$\times 1/[1/(1.1)+0.04]$	6.2		(27)
Windows Type 2			1.56	$\times 1/[1/(1.1)+0.04]$	1.64		(27)
Windows Type 3			5.88	$\times 1/[1/(1.1)+0.04]$	6.2		(27)
Windows Type 4			2	$\times 1/[1/(1.1)+0.04]$	2.11		(27)
Windows Type 5			2	$\times 1/[1/(1.1)+0.04]$	2.11		(27)
Walls	56.82	19.32	37.5	0.16	6		(29)
Total area of elements, m²			56.82				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 27.85 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 2625 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.52 (36)

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

Total fabric heat loss (33) + (36) = 36.37 (37)

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

(38)m= 12.99 12.82 12.66 11.85 11.69 10.88 10.88 10.72 11.21 11.69 12.02 12.34 (38)

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

(39)m= 49.36 49.2 49.03 48.23 48.06 47.26 47.26 47.09 47.58 48.06 48.39 48.71 (39)

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

48.19

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.9	0.9	0.89	0.88	0.88	0.86	0.86	0.86	0.87	0.88	0.88	0.89		
Average = Sum(40) _{1...12} /12=													0.88	(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

1.83

(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

77.77

(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=	85.54	82.43	79.32	76.21	73.1	69.99	69.99	73.1	76.21	79.32	82.43	85.54		
Total = Sum(44) _{1...12} =													933.21	(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=	126.86	110.95	114.49	99.82	95.78	82.65	76.59	87.88	88.93	103.64	113.13	122.86		
Total = Sum(45) _{1...12} =													1223.59	(45)

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

(46)m=	19.03	16.64	17.17	14.97	14.37	12.4	11.49	13.18	13.34	15.55	16.97	18.43		(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)

Water storage loss calculated for each month

((56)m = (55) x (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=	43.59	37.94	40.42	37.58	37.25	34.52	35.67	37.25	37.58	40.42	40.65	43.59	(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=	170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45	(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=	170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45	
Output from water heater (annual) _{1...12}												1690.07	(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=	53.08	46.38	48.17	42.59	41.16	36.11	34.38	38.53	38.97	44.57	47.78	51.75	(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=	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	(66)

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

(67)m=	14.26	12.66	10.3	7.8	5.83	4.92	5.32	6.91	9.28	11.78	13.75	14.65	(67)
--------	-------	-------	------	-----	------	------	------	------	------	-------	-------	-------	------

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

(68)m=	159.93	161.59	157.41	148.5	137.26	126.7	119.64	117.99	122.17	131.07	142.31	152.87	(68)
--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	(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=	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	71.34	69.01	64.75	59.15	55.32	50.15	46.21	51.79	54.12	59.9	66.36	69.55	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	299.04	296.78	285.97	268.96	251.93	235.29	224.69	230.21	239.08	256.27	275.93	290.6	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c			Gains (W)	
North	0.9x	0.77	x	5.88	x	10.63	x	0.75	x	0.85	=	27.62	(74)
North	0.9x	0.77	x	5.88	x	20.32	x	0.75	x	0.85	=	52.79	(74)
North	0.9x	0.77	x	5.88	x	34.53	x	0.75	x	0.85	=	89.7	(74)
North	0.9x	0.77	x	5.88	x	55.46	x	0.75	x	0.85	=	144.08	(74)
North	0.9x	0.77	x	5.88	x	74.72	x	0.75	x	0.85	=	194.09	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.88	x	79.99	x	0.75	x	0.85	=	207.78	(74)
North	0.9x	0.77	x	5.88	x	74.68	x	0.75	x	0.85	=	193.99	(74)
North	0.9x	0.77	x	5.88	x	59.25	x	0.75	x	0.85	=	153.9	(74)
North	0.9x	0.77	x	5.88	x	41.52	x	0.75	x	0.85	=	107.85	(74)
North	0.9x	0.77	x	5.88	x	24.19	x	0.75	x	0.85	=	62.84	(74)
North	0.9x	0.77	x	5.88	x	13.12	x	0.75	x	0.85	=	34.08	(74)
North	0.9x	0.77	x	5.88	x	8.86	x	0.75	x	0.85	=	23.03	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
Southwest	0.9x	0.77	x	1.56	x	36.79		0.75	x	0.85	=	25.36	(79)
Southwest	0.9x	0.77	x	1.56	x	62.67		0.75	x	0.85	=	43.19	(79)
Southwest	0.9x	0.77	x	1.56	x	85.75		0.75	x	0.85	=	59.1	(79)
Southwest	0.9x	0.77	x	1.56	x	106.25		0.75	x	0.85	=	73.23	(79)
Southwest	0.9x	0.77	x	1.56	x	119.01		0.75	x	0.85	=	82.02	(79)
Southwest	0.9x	0.77	x	1.56	x	118.15		0.75	x	0.85	=	81.43	(79)
Southwest	0.9x	0.77	x	1.56	x	113.91		0.75	x	0.85	=	78.5	(79)
Southwest	0.9x	0.77	x	1.56	x	104.39		0.75	x	0.85	=	71.94	(79)
Southwest	0.9x	0.77	x	1.56	x	92.85		0.75	x	0.85	=	63.99	(79)
Southwest	0.9x	0.77	x	1.56	x	69.27		0.75	x	0.85	=	47.74	(79)
Southwest	0.9x	0.77	x	1.56	x	44.07		0.75	x	0.85	=	30.37	(79)
Southwest	0.9x	0.77	x	1.56	x	31.49		0.75	x	0.85	=	21.7	(79)
West	0.9x	0.77	x	5.88	x	19.64	x	0.75	x	0.85	=	51.02	(80)
West	0.9x	0.77	x	5.88	x	38.42	x	0.75	x	0.85	=	99.81	(80)
West	0.9x	0.77	x	5.88	x	63.27	x	0.75	x	0.85	=	164.37	(80)
West	0.9x	0.77	x	5.88	x	92.28	x	0.75	x	0.85	=	239.72	(80)
West	0.9x	0.77	x	5.88	x	113.09	x	0.75	x	0.85	=	293.78	(80)
West	0.9x	0.77	x	5.88	x	115.77	x	0.75	x	0.85	=	300.74	(80)
West	0.9x	0.77	x	5.88	x	110.22	x	0.75	x	0.85	=	286.32	(80)
West	0.9x	0.77	x	5.88	x	94.68	x	0.75	x	0.85	=	245.94	(80)
West	0.9x	0.77	x	5.88	x	73.59	x	0.75	x	0.85	=	191.16	(80)
West	0.9x	0.77	x	5.88	x	45.59	x	0.75	x	0.85	=	118.43	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	5.88	x	24.49	x	0.75	x	0.85	=	63.62	(80)
West	0.9x	0.77	x	5.88	x	16.15	x	0.75	x	0.85	=	41.96	(80)
Northwest	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(81)
Northwest	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(81)
Northwest	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(81)
Northwest	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	123.94	236.37	386.29	577.11	731.31	762.04	719.8	600.13	452.11	278.6	153.15	102.97	(83)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	------

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

(84)m=	422.98	533.15	672.26	846.08	983.24	997.33	944.49	830.34	691.18	534.87	429.09	393.56	(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	0.97	0.88	0.67	0.45	0.3	0.22	0.26	0.47	0.83	0.98	0.99	(86)

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

(87)m=	20.27	20.51	20.79	20.97	21	21	21	21	21	20.9	20.54	20.23	(87)
--------	-------	-------	-------	-------	----	----	----	----	----	------	-------	-------	------

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

(88)m=	20.17	20.17	20.17	20.19	20.19	20.2	20.2	20.2	20.2	20.19	20.18	20.18	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

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

(89)m=	0.99	0.96	0.86	0.63	0.41	0.27	0.18	0.22	0.42	0.79	0.97	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

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

(90)m=	19.21	19.54	19.93	20.15	20.19	20.2	20.2	20.2	20.19	20.09	19.61	19.16	(90)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.49 (91)

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

(92)m=	19.73	20.01	20.35	20.55	20.58	20.59	20.59	20.59	20.59	20.49	20.07	19.68	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	19.58	19.86	20.2	20.4	20.43	20.44	20.44	20.44	20.44	20.34	19.92	19.53	(93)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.86	0.64	0.43	0.28	0.19	0.23	0.43	0.8	0.97	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	417.6	510.84	578.48	540.43	418.58	275.99	181.54	190.39	300.62	427.37	414.9	390.06	(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=	754.24	736.22	671.81	554.61	419.72	276.05	181.54	190.4	301.5	467.96	620.24	746.93	(97)
--------	--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	------

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

(98)m=	250.46	151.45	69.44	10.21	0.85	0	0	0	0	30.2	147.84	265.51	
--------	--------	--------	-------	-------	------	---	---	---	---	------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 925.96 (98)

Space heating requirement in kWh/m²/year

16.87 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

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

Space heating requirement (calculated above)

250.46	151.45	69.44	10.21	0.85	0	0	0	0	30.2	147.84	265.51
--------	--------	-------	-------	------	---	---	---	---	------	--------	--------

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

276.75	167.35	76.72	11.28	0.94	0	0	0	0	33.37	163.36	293.38
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 1023.16 (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)

170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45
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Efficiency of water heater 81.2 (216)

(217)m= 86.49 85.64 83.87 81.78 81.25 81.2 81.2 81.2 81.2 82.67 85.51 86.67 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	197.08	173.87	184.71	168.01	163.72	144.29	138.24	154.11	155.81	174.26	179.85	192.04
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Total = Sum(219a)_{1...12} = 2026 (219)

Annual totals

Space heating fuel used, main system 1

1023.16

Water heating fuel used

2026

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

144.67

(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) =	219.67	(231)
Electricity for lighting		251.8	(232)
Electricity generated by PVs		-786.92	(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	=	221	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	437.62	(264)
Space and water heating	(261) + (262) + (263) + (264) =			658.62	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	114.01	(267)
Electricity for lighting	(232) x	0.519	=	130.68	(268)
Energy saving/generation technologies Item 1		0.519	=	-408.41	(269)
Total CO2, kg/year		sum of (265)...(271) =		494.9	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.01	(273)
El rating (section 14)				93	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-MF-2B (East)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	72.75 (1a)	2.4 (2a)	174.6 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.75 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	174.6 (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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			2.94	$\times 1/[1/(1.1) + 0.04]$	3.1		(27)
Windows Type 2			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 3			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 4			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 5			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Walls	65.35	12.94	52.41	0.16	8.39		(29)
Total area of elements, m²			65.35				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 23.51 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3668.7 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.8 (36)

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

Total fabric heat loss (33) + (36) = 33.31 (37)

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

(38)m= 16.98 16.78 16.59 15.61 15.42 14.44 14.44 14.24 14.83 15.42 15.81 16.2 (38)

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

(39)m= 50.29 50.1 49.9 48.93 48.73 47.75 47.75 47.56 48.14 48.73 49.12 49.51
Average = Sum(39)_{1...12} /12= 48.88 (39)

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Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	0.69	0.69	0.69	0.67	0.67	0.66	0.66	0.65	0.66	0.67	0.68	0.68		
Average = Sum(40) _{1...12} /12=													0.67	(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

2.31

(42)

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

if TFA ≤ 13.9, N = 1

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

89.09

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
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Hot water usage in litres per day for each month Vd,m = factor from Table 1c × (43)

(44)m=	97.99	94.43	90.87	87.3	83.74	80.18	80.18	83.74	87.3	90.87	94.43	97.99		
Total = Sum(44) _{1...12} =													1069.03	(44)

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

(45)m=	145.32	127.1	131.16	114.35	109.72	94.68	87.73	100.67	101.88	118.73	129.6	140.74		
Total = Sum(45) _{1...12} =													1401.67	(45)

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

(46)m=	21.8	19.07	19.67	17.15	16.46	14.2	13.16	15.1	15.28	17.81	19.44	21.11		(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) × (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) × (51) × (52) × (53) =

0

(54)

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

0

(55)

Water storage loss calculated for each month

((56)m = (55) × (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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

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

(61)m=	49.94	43.46	46.31	43.05	42.67	39.54	40.86	42.67	43.05	46.31	46.57	49.94	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	195.26	170.57	177.46	157.4	152.39	134.22	128.59	143.35	144.93	165.03	176.17	190.67	(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	195.26	170.57	177.46	157.4	152.39	134.22	128.59	143.35	144.93	165.03	176.17	190.67	
Output from water heater (annual) _{1...12}												1936.04	(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=	60.8	53.13	55.19	48.78	47.15	41.37	39.39	44.14	44.64	51.05	54.73	59.28	(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=	115.55	115.55	115.55	115.55	115.55	115.55	115.55	115.55	115.55	115.55	115.55	115.55	(66)

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

(67)m=	19.23	17.08	13.89	10.52	7.86	6.64	7.17	9.32	12.51	15.89	18.54	19.76	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	203.63	205.74	200.42	189.08	174.77	161.32	152.34	150.23	155.55	166.89	181.19	194.64	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	34.55	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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=	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	-92.44	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	81.73	79.06	74.17	67.75	63.37	57.45	52.94	59.33	62	68.62	76.02	79.68	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	------

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

(73)m=	365.25	362.54	349.15	328.02	306.67	286.08	273.11	279.54	290.72	312.06	336.42	354.75	(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)	
Northeast 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)

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Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.77	x	2.94	x	19.64	x	0.75	x	0.85	=	25.51	(76)
East	0.9x	0.77	x	2.94	x	38.42	x	0.75	x	0.85	=	49.9	(76)
East	0.9x	0.77	x	2.94	x	63.27	x	0.75	x	0.85	=	82.18	(76)
East	0.9x	0.77	x	2.94	x	92.28	x	0.75	x	0.85	=	119.86	(76)
East	0.9x	0.77	x	2.94	x	113.09	x	0.75	x	0.85	=	146.89	(76)
East	0.9x	0.77	x	2.94	x	115.77	x	0.75	x	0.85	=	150.37	(76)
East	0.9x	0.77	x	2.94	x	110.22	x	0.75	x	0.85	=	143.16	(76)
East	0.9x	0.77	x	2.94	x	94.68	x	0.75	x	0.85	=	122.97	(76)
East	0.9x	0.77	x	2.94	x	73.59	x	0.75	x	0.85	=	95.58	(76)
East	0.9x	0.77	x	2.94	x	45.59	x	0.75	x	0.85	=	59.21	(76)
East	0.9x	0.77	x	2.94	x	24.49	x	0.75	x	0.85	=	31.81	(76)
East	0.9x	0.77	x	2.94	x	16.15	x	0.75	x	0.85	=	20.98	(76)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.75	x	0.85	=	32.51	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.75	x	0.85	=	55.38	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.75	x	0.85	=	75.77	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.75	x	0.85	=	93.88	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.75	x	0.85	=	105.15	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.75	x	0.85	=	104.39	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.75	x	0.85	=	100.65	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.75	x	0.85	=	92.24	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.75	x	0.85	=	82.04	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.75	x	0.85	=	61.2	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.75	x	0.85	=	38.94	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.75	x	0.85	=	27.82	(77)
South	0.9x	0.54	x	2	x	46.75	x	0.75	x	0.85	=	28.97	(78)
South	0.9x	0.54	x	2	x	76.57	x	0.75	x	0.85	=	47.45	(78)
South	0.9x	0.54	x	2	x	97.53	x	0.75	x	0.85	=	60.44	(78)
South	0.9x	0.54	x	2	x	110.23	x	0.75	x	0.85	=	68.31	(78)
South	0.9x	0.54	x	2	x	114.87	x	0.75	x	0.85	=	71.18	(78)
South	0.9x	0.54	x	2	x	110.55	x	0.75	x	0.85	=	68.5	(78)
South	0.9x	0.54	x	2	x	108.01	x	0.75	x	0.85	=	66.93	(78)
South	0.9x	0.54	x	2	x	104.89	x	0.75	x	0.85	=	65	(78)
South	0.9x	0.54	x	2	x	101.89	x	0.75	x	0.85	=	63.13	(78)
South	0.9x	0.54	x	2	x	82.59	x	0.75	x	0.85	=	51.17	(78)

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South	0.9x	0.54	x	2	x	55.42	x	0.75	x	0.85	=	34.34	(78)
South	0.9x	0.54	x	2	x	40.4	x	0.75	x	0.85	=	25.03	(78)
West	0.9x	0.54	x	2	x	19.64	x	0.75	x	0.85	=	12.17	(80)
West	0.9x	0.54	x	2	x	38.42	x	0.75	x	0.85	=	23.81	(80)
West	0.9x	0.54	x	2	x	63.27	x	0.75	x	0.85	=	39.21	(80)
West	0.9x	0.54	x	2	x	92.28	x	0.75	x	0.85	=	57.18	(80)
West	0.9x	0.54	x	2	x	113.09	x	0.75	x	0.85	=	70.08	(80)
West	0.9x	0.54	x	2	x	115.77	x	0.75	x	0.85	=	71.74	(80)
West	0.9x	0.54	x	2	x	110.22	x	0.75	x	0.85	=	68.3	(80)
West	0.9x	0.54	x	2	x	94.68	x	0.75	x	0.85	=	58.67	(80)
West	0.9x	0.54	x	2	x	73.59	x	0.75	x	0.85	=	45.6	(80)
West	0.9x	0.54	x	2	x	45.59	x	0.75	x	0.85	=	28.25	(80)
West	0.9x	0.54	x	2	x	24.49	x	0.75	x	0.85	=	15.17	(80)
West	0.9x	0.54	x	2	x	16.15	x	0.75	x	0.85	=	10.01	(80)

Solar gains in watts, calculated for each month

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

(83)m=	109.13	196.82	294.16	399.27	474.01	481.05	459.53	403.04	330.91	224.64	132.81	91.98	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

(84)m=	474.38	559.37	643.3	727.29	780.68	767.12	732.64	682.58	621.63	536.7	469.23	446.73	(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	0.78	0.58	0.4	0.29	0.32	0.53	0.86	0.98	1	(86)

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

(87)m=	20.48	20.64	20.82	20.96	21	21	21	21	21	20.94	20.69	20.45	(87)
--------	-------	-------	-------	-------	----	----	----	----	----	-------	-------	-------	------

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

(88)m=	20.35	20.35	20.35	20.37	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(89)m=	0.99	0.98	0.91	0.75	0.54	0.36	0.25	0.28	0.49	0.83	0.98	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.66	19.88	20.14	20.33	20.36	20.38	20.38	20.38	20.37	20.3	19.96	19.62	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.51 (91)

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

(92)m=	20.08	20.27	20.49	20.65	20.69	20.7	20.7	20.7	20.69	20.63	20.33	20.05	(92)
--------	-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	------

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

(93)m=	19.93	20.12	20.34	20.5	20.54	20.55	20.55	20.55	20.54	20.48	20.18	19.9	(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	0.91	0.75	0.55	0.37	0.26	0.29	0.5	0.83	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	470.47	544.76	588.35	547.81	428.92	283.93	188.49	197.28	309.62	447.52	457.83	444.19	(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=	785.99	762.36	690.68	567.68	430.67	283.99	188.49	197.28	310.22	481.3	642.7	777.27	(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=	234.75	146.23	76.13	14.3	1.31	0	0	0	0	25.13	133.11	247.81	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 878.76 (98)

Space heating requirement in kWh/m²/year

12.08 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

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

Space heating requirement (calculated above)

234.75	146.23	76.13	14.3	1.31	0	0	0	0	25.13	133.11	247.81
--------	--------	-------	------	------	---	---	---	---	-------	--------	--------

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

259.39	161.58	84.12	15.8	1.44	0	0	0	0	27.77	147.08	273.82
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 971 (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 0 (215)

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

Water heating

Output from water heater (calculated above)

195.26	170.57	177.46	157.4	152.39	134.22	128.59	143.35	144.93	165.03	176.17	190.67
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Efficiency of water heater 81.2 (216)

(217)m= 86.03 85.24 83.78 81.9 81.27 81.2 81.2 81.2 81.2 82.32 84.96 86.21 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	226.98	200.09	211.81	192.18	187.51	165.29	158.36	176.54	178.49	200.48	207.36	221.18
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Total = Sum(219a)_{1...12} = 2326.28 (219)

Annual totals

kWh/year kWh/year

Space heating fuel used, main system 1 971

Water heating fuel used 2326.28

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 157.1 (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) =	232.1	(231)
Electricity for lighting		339.61	(232)
Electricity generated by PVs		-786.92	(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	=	209.74	(261)
Space heating (secondary)	(215) x		0.519	=	0	(263)
Water heating	(219) x		0.216	=	502.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =				712.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	120.46	(267)
Electricity for lighting	(232) x		0.519	=	176.26	(268)
Energy saving/generation technologies Item 1			0.519	=	-408.41	(269)
Total CO2, kg/year		sum of (265)...(271) =			600.52	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			8.25	(273)
El rating (section 14)					93	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-MF-2B (North)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61.8 (1a) x	2.4 (2a) =	148.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.32 (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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	1.8	3.6		(26)
Windows Type 1			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 2			1.56	$\times 1/[1/(1.1) + 0.04]$	1.64		(27)
Windows Type 3			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 4			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 5			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Walls	63	19.32	43.68	0.16	6.99		(29)
Total area of elements, m²			63				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 28.84 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3057.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 9.45 (36)

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

Total fabric heat loss (33) + (36) = 38.29 (37)

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

(38)m= 14.42 14.26 14.09 13.26 13.1 12.27 12.27 12.1 12.6 13.1 13.43 13.76 (38)

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

(39)m= 52.71 52.54 52.38 51.55 51.38 50.55 50.55 50.39 50.89 51.38 51.71 52.05 (39)

Average = Sum(39)_{1...12} /12= 51.51

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	0.82	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

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

$$\text{if TFA} \leq 13.9, N = 1$$

2.03 (42)

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

82.46 (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 $V_{d,m}$ = factor from Table 1c x (43)														
(44)m=	90.71	87.41	84.11	80.81	77.51	74.21	74.21	77.51	80.81	84.11	87.41	90.71		
Total = Sum(44) _{1...12} =													989.53	(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=	134.52	117.65	121.4	105.84	101.56	87.64	81.21	93.19	94.3	109.9	119.96	130.27		
Total = Sum(45) _{1...12} =													1297.43	(45)

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

(46)m=	20.18	17.65	18.21	15.88	15.23	13.15	12.18	13.98	14.15	16.48	17.99	19.54		(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)
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If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, 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 $(59)m = (58) \div 365 \times (41)m$

(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)
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DER WorkSheet: New dwelling design stage

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

(61)m=	46.22	40.23	42.86	39.85	39.5	36.6	37.82	39.5	39.85	42.86	43.11	46.22	(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=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	(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=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	
Output from water heater (annual) _{1...12}												1792.06	(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=	56.28	49.18	51.08	45.16	43.64	38.29	36.46	40.86	41.32	47.26	50.66	54.87	(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=	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	(66)

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

(67)m=	15.82	14.05	11.43	8.65	6.47	5.46	5.9	7.67	10.29	13.07	15.25	16.26	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	177.46	179.3	174.66	164.78	152.31	140.59	132.76	130.92	135.56	145.44	157.91	169.63	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	(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=	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	(71)
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Water heating gains (Table 5)

(72)m=	75.65	73.18	68.66	62.72	58.66	53.18	49	54.92	57.39	63.52	70.37	73.75	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	325.41	323.02	311.23	292.63	273.92	255.71	244.14	249.99	259.72	278.51	300.01	316.13	(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)	
North	0.9x	0.77	x	5.88	x	10.63	x	0.75	x	0.85	=	27.62	(74)
North	0.9x	0.77	x	5.88	x	20.32	x	0.75	x	0.85	=	52.79	(74)
North	0.9x	0.77	x	5.88	x	34.53	x	0.75	x	0.85	=	89.7	(74)
North	0.9x	0.77	x	5.88	x	55.46	x	0.75	x	0.85	=	144.08	(74)
North	0.9x	0.77	x	5.88	x	74.72	x	0.75	x	0.85	=	194.09	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.88	x	79.99	x	0.75	x	0.85	=	207.78	(74)
North	0.9x	0.77	x	5.88	x	74.68	x	0.75	x	0.85	=	193.99	(74)
North	0.9x	0.77	x	5.88	x	59.25	x	0.75	x	0.85	=	153.9	(74)
North	0.9x	0.77	x	5.88	x	41.52	x	0.75	x	0.85	=	107.85	(74)
North	0.9x	0.77	x	5.88	x	24.19	x	0.75	x	0.85	=	62.84	(74)
North	0.9x	0.77	x	5.88	x	13.12	x	0.75	x	0.85	=	34.08	(74)
North	0.9x	0.77	x	5.88	x	8.86	x	0.75	x	0.85	=	23.03	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.54	x	5.88	x	19.64	x	0.75	x	0.85	=	35.78	(76)
East	0.9x	0.54	x	5.88	x	38.42	x	0.75	x	0.85	=	69.99	(76)
East	0.9x	0.54	x	5.88	x	63.27	x	0.75	x	0.85	=	115.27	(76)
East	0.9x	0.54	x	5.88	x	92.28	x	0.75	x	0.85	=	168.11	(76)
East	0.9x	0.54	x	5.88	x	113.09	x	0.75	x	0.85	=	206.03	(76)
East	0.9x	0.54	x	5.88	x	115.77	x	0.75	x	0.85	=	210.91	(76)
East	0.9x	0.54	x	5.88	x	110.22	x	0.75	x	0.85	=	200.79	(76)
East	0.9x	0.54	x	5.88	x	94.68	x	0.75	x	0.85	=	172.48	(76)
East	0.9x	0.54	x	5.88	x	73.59	x	0.75	x	0.85	=	134.06	(76)
East	0.9x	0.54	x	5.88	x	45.59	x	0.75	x	0.85	=	83.05	(76)
East	0.9x	0.54	x	5.88	x	24.49	x	0.75	x	0.85	=	44.61	(76)
East	0.9x	0.54	x	5.88	x	16.15	x	0.75	x	0.85	=	29.42	(76)
Southeast	0.9x	0.54	x	1.56	x	36.79	x	0.75	x	0.85	=	17.78	(77)
Southeast	0.9x	0.54	x	1.56	x	62.67	x	0.75	x	0.85	=	30.29	(77)
Southeast	0.9x	0.54	x	1.56	x	85.75	x	0.75	x	0.85	=	41.45	(77)
Southeast	0.9x	0.54	x	1.56	x	106.25	x	0.75	x	0.85	=	51.35	(77)
Southeast	0.9x	0.54	x	1.56	x	119.01	x	0.75	x	0.85	=	57.52	(77)
Southeast	0.9x	0.54	x	1.56	x	118.15	x	0.75	x	0.85	=	57.11	(77)
Southeast	0.9x	0.54	x	1.56	x	113.91	x	0.75	x	0.85	=	55.06	(77)
Southeast	0.9x	0.54	x	1.56	x	104.39	x	0.75	x	0.85	=	50.45	(77)
Southeast	0.9x	0.54	x	1.56	x	92.85	x	0.75	x	0.85	=	44.88	(77)
Southeast	0.9x	0.54	x	1.56	x	69.27	x	0.75	x	0.85	=	33.48	(77)

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.54	x	1.56	x	44.07	x	0.75	x	0.85	=	21.3	(77)
Southeast 0.9x	0.54	x	1.56	x	31.49	x	0.75	x	0.85	=	15.22	(77)
Northwest 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(81)
Northwest 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(81)
Northwest 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(81)
Northwest 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest 0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest 0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest 0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest 0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest 0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest 0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest 0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	101.12	193.66	319.54	483.64	619.06	647.88	610.83	505.18	375.89	228.97	125.08	83.95	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	426.54	516.67	630.77	776.27	892.98	903.6	854.97	755.17	635.61	507.48	425.09	400.08	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.98	0.93	0.76	0.53	0.36	0.26	0.31	0.55	0.89	0.99	1	(86)

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

(87)m=	20.27	20.46	20.72	20.94	20.99	21	21	21	20.99	20.87	20.52	20.23	(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)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.92	0.72	0.49	0.32	0.22	0.26	0.49	0.86	0.98	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.23	19.51	19.88	20.16	20.22	20.24	20.24	20.24	20.23	20.08	19.6	19.19	(90)
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fLA = Living area ÷ (4) =

0.42 (91)

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

(92)m=	19.66	19.9	20.23	20.49	20.54	20.55	20.55	20.56	20.55	20.41	19.98	19.62	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.51	19.75	20.08	20.34	20.39	20.4	20.4	20.41	20.4	20.26	19.83	19.47	(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=	0.99	0.98	0.91	0.73	0.5	0.32	0.22	0.27	0.5	0.86	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	423.05	503.84	575.29	562.82	444.25	293.29	192.3	201.8	318.73	435.42	416.12	397.77	(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=	801.82	780.34	711.33	589.56	446.62	293.4	192.31	201.82	320.44	496.3	658.52	794.95	(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=	281.81	185.81	101.21	19.25	1.76	0	0	0	0	45.29	174.53	295.5	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

1105.16 (98)

Space heating requirement in kWh/m²/year

17.88 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

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

1 (202)

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

1 (204)

Efficiency of main space heating system 1

90.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

281.81	185.81	101.21	19.25	1.76	0	0	0	0	45.29	174.53	295.5
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(211)m = [(98)m x (204)] } x 100 ÷ (206) (211)

311.39	205.31	111.84	21.27	1.95	0	0	0	0	50.05	192.85	326.52
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Total (kWh/year) = Sum(211)_{1...5,10...12} =

1221.18 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] } x 100 ÷ (208)

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

0 (215)

Water heating

Output from water heater (calculated above)

180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49
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Efficiency of water heater

81.2 (216)

(217)m=

86.62	85.98	84.51	82.19	81.3	81.2	81.2	81.2	81.2	83.15	85.76	86.78
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	208.65	183.63	194.37	177.27	173.5	153	146.59	163.41	165.21	183.71	190.15	203.37	
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Total = Sum(219a)_{1...12} =

2142.87 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1221.18

Water heating fuel used

2142.87

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

133.45 (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) =	208.45	(231)
Electricity for lighting		279.4	(232)
Electricity generated by PVs		-786.92	(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	=	263.77	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	462.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =			726.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	108.19	(267)
Electricity for lighting	(232) x	0.519	=	145.01	(268)
Energy saving/generation technologies Item 1		0.519	=	-408.41	(269)
Total CO2, kg/year		sum of (265)...(271) =		571.42	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.25	(273)
El rating (section 14)				93	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-TF-1B (North)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	54.9 (1a) x	2.4 (2a) =	131.76 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.9 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	131.76 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	+	0 = 0 (6a)
Number of open flues	0	+	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			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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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

0.21	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:

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) =

78.2 (23c)

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

(24a)m= 0.32 0.31 0.31 0.29 0.28 0.26 0.26 0.26 0.27 0.28 0.29 0.3 (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= 0.32 0.31 0.31 0.29 0.28 0.26 0.26 0.26 0.27 0.28 0.29 0.3 (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	1.8	3.6		(26)
Windows Type 1			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 2			1.56	$\times 1/[1/(1.1) + 0.04]$	1.64		(27)
Windows Type 3			3.36	$\times 1/[1/(1.1) + 0.04]$	3.54		(27)
Windows Type 4			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 5			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Walls	56.82	16.8	40.02	0.16	6.4		(29)
Roof	54.9	0	54.9	0.11	6.04		(30)
Total area of elements, m²			111.72				(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 31.64 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3295.5 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 16.76 (36)

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

Total fabric heat loss (33) + (36) = 48.39 (37)

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

(38)m= 13.71 13.54 13.36 12.48 12.31 11.43 11.43 11.25 11.78 12.31 12.66 13.01 (38)

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

(39)m= 62.11 61.93 61.76 60.88 60.7 59.82 59.82 59.64 60.17 60.7 61.05 61.4 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.13	1.13	1.12	1.11	1.11	1.09	1.09	1.09	1.1	1.11	1.11	1.12		
Average = Sum(40) _{1...12} /12=													1.11	(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

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

if TFA ≤ 13.9, N = 1

1.83 (42)

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

77.77 (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 × (43)														
(44)m=	85.54	82.43	79.32	76.21	73.1	69.99	69.99	73.1	76.21	79.32	82.43	85.54		
Total = Sum(44) _{1...12} =													933.21	(44)

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

(45)m=	126.86	110.95	114.49	99.82	95.78	82.65	76.59	87.88	88.93	103.64	113.13	122.86		
Total = Sum(45) _{1...12} =													1223.59	(45)

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

(46)m=	19.03	16.64	17.17	14.97	14.37	12.4	11.49	13.18	13.34	15.55	16.97	18.43		(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) × (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) × (51) × (52) × (53) = 0 (54)

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

Water storage loss calculated for each month ((56)m = (55) × (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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	--	------

DER WorkSheet: New dwelling design stage

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

(61)m=	43.59	37.94	40.42	37.58	37.25	34.52	35.67	37.25	37.58	40.42	40.65	43.59	(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=	170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45	(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=	170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45	
Output from water heater (annual) _{1...12}												1690.07	(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=	53.08	46.38	48.17	42.59	41.16	36.11	34.38	38.53	38.97	44.57	47.78	51.75	(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=	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	91.72	(66)

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

(67)m=	14.26	12.66	10.3	7.8	5.83	4.92	5.32	6.91	9.28	11.78	13.75	14.65	(67)
--------	-------	-------	------	-----	------	------	------	------	------	-------	-------	-------	------

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

(68)m=	159.93	161.59	157.41	148.5	137.26	126.7	119.64	117.99	122.17	131.07	142.31	152.87	(68)
--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	32.17	(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)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	-73.38	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	71.34	69.01	64.75	59.15	55.32	50.15	46.21	51.79	54.12	59.9	66.36	69.55	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

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

(73)m=	299.04	296.78	285.97	268.96	251.93	235.29	224.69	230.21	239.08	256.27	275.93	290.6	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.36	x	10.63	x	0.75	x	0.85	=	15.78	(74)
North	0.9x	0.77	x	3.36	x	20.32	x	0.75	x	0.85	=	30.16	(74)
North	0.9x	0.77	x	3.36	x	34.53	x	0.75	x	0.85	=	51.26	(74)
North	0.9x	0.77	x	3.36	x	55.46	x	0.75	x	0.85	=	82.33	(74)
North	0.9x	0.77	x	3.36	x	74.72	x	0.75	x	0.85	=	110.91	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.36	x	79.99	x	0.75	x	0.85	=	118.73	(74)
North	0.9x	0.77	x	3.36	x	74.68	x	0.75	x	0.85	=	110.85	(74)
North	0.9x	0.77	x	3.36	x	59.25	x	0.75	x	0.85	=	87.95	(74)
North	0.9x	0.77	x	3.36	x	41.52	x	0.75	x	0.85	=	61.63	(74)
North	0.9x	0.77	x	3.36	x	24.19	x	0.75	x	0.85	=	35.91	(74)
North	0.9x	0.77	x	3.36	x	13.12	x	0.75	x	0.85	=	19.47	(74)
North	0.9x	0.77	x	3.36	x	8.86	x	0.75	x	0.85	=	13.16	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
Southwest	0.9x	0.77	x	1.56	x	36.79		0.75	x	0.85	=	25.36	(79)
Southwest	0.9x	0.77	x	1.56	x	62.67		0.75	x	0.85	=	43.19	(79)
Southwest	0.9x	0.77	x	1.56	x	85.75		0.75	x	0.85	=	59.1	(79)
Southwest	0.9x	0.77	x	1.56	x	106.25		0.75	x	0.85	=	73.23	(79)
Southwest	0.9x	0.77	x	1.56	x	119.01		0.75	x	0.85	=	82.02	(79)
Southwest	0.9x	0.77	x	1.56	x	118.15		0.75	x	0.85	=	81.43	(79)
Southwest	0.9x	0.77	x	1.56	x	113.91		0.75	x	0.85	=	78.5	(79)
Southwest	0.9x	0.77	x	1.56	x	104.39		0.75	x	0.85	=	71.94	(79)
Southwest	0.9x	0.77	x	1.56	x	92.85		0.75	x	0.85	=	63.99	(79)
Southwest	0.9x	0.77	x	1.56	x	69.27		0.75	x	0.85	=	47.74	(79)
Southwest	0.9x	0.77	x	1.56	x	44.07		0.75	x	0.85	=	30.37	(79)
Southwest	0.9x	0.77	x	1.56	x	31.49		0.75	x	0.85	=	21.7	(79)
West	0.9x	0.77	x	5.88	x	19.64	x	0.75	x	0.85	=	51.02	(80)
West	0.9x	0.77	x	5.88	x	38.42	x	0.75	x	0.85	=	99.81	(80)
West	0.9x	0.77	x	5.88	x	63.27	x	0.75	x	0.85	=	164.37	(80)
West	0.9x	0.77	x	5.88	x	92.28	x	0.75	x	0.85	=	239.72	(80)
West	0.9x	0.77	x	5.88	x	113.09	x	0.75	x	0.85	=	293.78	(80)
West	0.9x	0.77	x	5.88	x	115.77	x	0.75	x	0.85	=	300.74	(80)
West	0.9x	0.77	x	5.88	x	110.22	x	0.75	x	0.85	=	286.32	(80)
West	0.9x	0.77	x	5.88	x	94.68	x	0.75	x	0.85	=	245.94	(80)
West	0.9x	0.77	x	5.88	x	73.59	x	0.75	x	0.85	=	191.16	(80)
West	0.9x	0.77	x	5.88	x	45.59	x	0.75	x	0.85	=	118.43	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.77	x	5.88	x	24.49	x	0.75	x	0.85	=	63.62	(80)
West	0.9x	0.77	x	5.88	x	16.15	x	0.75	x	0.85	=	41.96	(80)
Northwest	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(81)
Northwest	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(81)
Northwest	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(81)
Northwest	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	112.1	213.75	347.84	515.36	648.13	672.99	636.66	534.17	405.88	251.67	138.55	93.1	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	411.15	510.53	633.82	784.33	900.06	908.28	861.35	764.38	644.96	507.94	414.48	383.69	(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	0.94	0.81	0.61	0.42	0.31	0.36	0.62	0.91	0.99	1	(86)

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

(87)m=	19.92	20.15	20.49	20.83	20.97	21	21	21	20.97	20.71	20.24	19.88	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.98	19.98	19.98	19.99	20	20.01	20.01	20.01	20	20	19.99	19.99	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.93	0.77	0.55	0.36	0.24	0.28	0.54	0.88	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.55	18.89	19.36	19.81	19.97	20.01	20.01	20.01	19.99	19.69	19.03	18.51	(90)
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fLA = Living area ÷ (4) =

0.49 (91)

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

(92)m=	19.22	19.5	19.91	20.31	20.46	20.49	20.49	20.47	20.19	19.62	19.18	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.07	19.35	19.76	20.16	20.31	20.34	20.34	20.34	20.32	20.04	19.47	19.03	(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=	0.99	0.97	0.92	0.78	0.57	0.38	0.26	0.31	0.57	0.88	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	407.31	497.63	585.05	609.23	508.88	342.11	223.79	234.92	364.71	449.2	405.84	381.07	(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=	917.5	895.16	819.13	685.36	522.38	343.4	223.93	235.25	374.17	572.95	755.49	910.54	(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=	379.58	267.15	174.16	54.81	10.05	0	0	0	0	92.07	251.75	393.93	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	--------	--------	--

Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1623.5 (98)

Space heating requirement in kWh/m²/year

29.57 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

379.58	267.15	174.16	54.81	10.05	0	0	0	0	92.07	251.75	393.93
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

419.43	295.19	192.44	60.57	11.1	0	0	0	0	101.73	278.18	435.28
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 1793.92 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

170.45	148.89	154.92	137.4	133.03	117.16	112.25	125.14	126.52	144.07	153.79	166.45
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Efficiency of water heater 81.2 (216)

(217)m= 87.4 86.94 85.87 83.65 81.79 81.2 81.2 81.2 81.2 84.59 86.73 87.52 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	195.03	171.27	180.41	164.26	162.65	144.29	138.24	154.11	155.81	170.31	177.31	190.18
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Total = Sum(219a)_{1...12} = 2003.86 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1 1793.92

Water heating fuel used 2003.86

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside 144.67 (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) =	219.67	(231)
Electricity for lighting		251.8	(232)
Electricity generated by PVs		-535.96	(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	=	387.49	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	432.83	(264)
Space and water heating	(261) + (262) + (263) + (264) =			820.32	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	114.01	(267)
Electricity for lighting	(232) x	0.519	=	130.68	(268)
Energy saving/generation technologies Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		786.85	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.33	(273)
El rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-TF-2B (North)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	61.8 (1a)	2.4 (2a)	148.32 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.8 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	148.32 (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			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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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

0.21	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) 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) =

75.65 (23c)

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

(24a)m= 0.33 0.32 0.32 0.3 0.3 0.28 0.28 0.27 0.28 0.3 0.3 0.31 (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 0.32 0.32 0.3 0.3 0.28 0.28 0.27 0.28 0.3 0.3 0.31 (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	x 1.8	= 3.6		(26)
Windows Type 1			5.88	x 1/[1/(1.1)+0.04]	= 6.2		(27)
Windows Type 2			1.56	x 1/[1/(1.1)+0.04]	= 1.64		(27)
Windows Type 3			3.36	x 1/[1/(1.1)+0.04]	= 3.54		(27)
Windows Type 4			2	x 1/[1/(1.1)+0.04]	= 2.11		(27)
Windows Type 5			2	x 1/[1/(1.1)+0.04]	= 2.11		(27)
Walls	63	16.8	46.2	x 0.16	= 7.39		(29)
Roof	61.8	0	61.8	x 0.11	= 6.8		(30)
Total area of elements, m²			124.8				(31)

* 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) = 33.38 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 3790.2 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.72 (36)

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

Total fabric heat loss (33) + (36) = 52.1 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m=	16.06	15.86	15.66	14.67	14.48	13.49	13.49	13.29	13.88	14.48	14.87	15.27

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

(39)m= 68.16 67.97 67.77 66.78 66.58 65.59 65.59 65.39 65.99 66.58 66.98 67.37 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09		
Average = Sum(40) _{1...12} /12=													1.08	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

2.03

(42)

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

if TFA ≤ 13.9, N = 1

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

82.46

(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 × (43)

(44)m=	90.71	87.41	84.11	80.81	77.51	74.21	74.21	77.51	80.81	84.11	87.41	90.71		
Total = Sum(44) _{1...12} =													989.53	(44)

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

(45)m=	134.52	117.65	121.4	105.84	101.56	87.64	81.21	93.19	94.3	109.9	119.96	130.27		
Total = Sum(45) _{1...12} =													1297.43	(45)

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

(46)m=	20.18	17.65	18.21	15.88	15.23	13.15	12.18	13.98	14.15	16.48	17.99	19.54		(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) × (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) × (51) × (52) × (53) =

0

(54)

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

0

(55)

Water storage loss calculated for each month

((56)m = (55) × (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)
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DER WorkSheet: New dwelling design stage

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

(61)m=	46.22	40.23	42.86	39.85	39.5	36.6	37.82	39.5	39.85	42.86	43.11	46.22	(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=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	(62)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

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

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

(64)m=	180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49	
Output from water heater (annual) _{1...12}												1792.06	(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=	56.28	49.18	51.08	45.16	43.64	38.29	36.46	40.86	41.32	47.26	50.66	54.87	(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=	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	(66)

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

(67)m=	15.82	14.05	11.43	8.65	6.47	5.46	5.9	7.67	10.29	13.07	15.25	16.26	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	177.46	179.3	174.66	164.78	152.31	140.59	132.76	130.92	135.56	145.44	157.91	169.63	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	33.16	(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=	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	-81.28	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	75.65	73.18	68.66	62.72	58.66	53.18	49	54.92	57.39	63.52	70.37	73.75	(72)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

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

(73)m=	325.41	323.02	311.23	292.63	273.92	255.71	244.14	249.99	259.72	278.51	300.01	316.13	(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)	
North	0.9x	0.77	x	3.36	x	10.63	x	0.75	x	0.85	=	15.78	(74)
North	0.9x	0.77	x	3.36	x	20.32	x	0.75	x	0.85	=	30.16	(74)
North	0.9x	0.77	x	3.36	x	34.53	x	0.75	x	0.85	=	51.26	(74)
North	0.9x	0.77	x	3.36	x	55.46	x	0.75	x	0.85	=	82.33	(74)
North	0.9x	0.77	x	3.36	x	74.72	x	0.75	x	0.85	=	110.91	(74)

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North	0.9x	0.77	x	3.36	x	79.99	x	0.75	x	0.85	=	118.73	(74)
North	0.9x	0.77	x	3.36	x	74.68	x	0.75	x	0.85	=	110.85	(74)
North	0.9x	0.77	x	3.36	x	59.25	x	0.75	x	0.85	=	87.95	(74)
North	0.9x	0.77	x	3.36	x	41.52	x	0.75	x	0.85	=	61.63	(74)
North	0.9x	0.77	x	3.36	x	24.19	x	0.75	x	0.85	=	35.91	(74)
North	0.9x	0.77	x	3.36	x	13.12	x	0.75	x	0.85	=	19.47	(74)
North	0.9x	0.77	x	3.36	x	8.86	x	0.75	x	0.85	=	13.16	(74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(75)
East	0.9x	0.54	x	5.88	x	19.64	x	0.75	x	0.85	=	35.78	(76)
East	0.9x	0.54	x	5.88	x	38.42	x	0.75	x	0.85	=	69.99	(76)
East	0.9x	0.54	x	5.88	x	63.27	x	0.75	x	0.85	=	115.27	(76)
East	0.9x	0.54	x	5.88	x	92.28	x	0.75	x	0.85	=	168.11	(76)
East	0.9x	0.54	x	5.88	x	113.09	x	0.75	x	0.85	=	206.03	(76)
East	0.9x	0.54	x	5.88	x	115.77	x	0.75	x	0.85	=	210.91	(76)
East	0.9x	0.54	x	5.88	x	110.22	x	0.75	x	0.85	=	200.79	(76)
East	0.9x	0.54	x	5.88	x	94.68	x	0.75	x	0.85	=	172.48	(76)
East	0.9x	0.54	x	5.88	x	73.59	x	0.75	x	0.85	=	134.06	(76)
East	0.9x	0.54	x	5.88	x	45.59	x	0.75	x	0.85	=	83.05	(76)
East	0.9x	0.54	x	5.88	x	24.49	x	0.75	x	0.85	=	44.61	(76)
East	0.9x	0.54	x	5.88	x	16.15	x	0.75	x	0.85	=	29.42	(76)
Southeast	0.9x	0.54	x	1.56	x	36.79	x	0.75	x	0.85	=	17.78	(77)
Southeast	0.9x	0.54	x	1.56	x	62.67	x	0.75	x	0.85	=	30.29	(77)
Southeast	0.9x	0.54	x	1.56	x	85.75	x	0.75	x	0.85	=	41.45	(77)
Southeast	0.9x	0.54	x	1.56	x	106.25	x	0.75	x	0.85	=	51.35	(77)
Southeast	0.9x	0.54	x	1.56	x	119.01	x	0.75	x	0.85	=	57.52	(77)
Southeast	0.9x	0.54	x	1.56	x	118.15	x	0.75	x	0.85	=	57.11	(77)
Southeast	0.9x	0.54	x	1.56	x	113.91	x	0.75	x	0.85	=	55.06	(77)
Southeast	0.9x	0.54	x	1.56	x	104.39	x	0.75	x	0.85	=	50.45	(77)
Southeast	0.9x	0.54	x	1.56	x	92.85	x	0.75	x	0.85	=	44.88	(77)
Southeast	0.9x	0.54	x	1.56	x	69.27	x	0.75	x	0.85	=	33.48	(77)

DER WorkSheet: New dwelling design stage

Southeast 0.9x	0.54	x	1.56	x	44.07	x	0.75	x	0.85	=	21.3	(77)
Southeast 0.9x	0.54	x	1.56	x	31.49	x	0.75	x	0.85	=	15.22	(77)
Northwest 0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97	(81)
Northwest 0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29	(81)
Northwest 0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56	(81)
Northwest 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest 0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest 0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest 0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest 0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest 0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest 0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest 0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	89.29	171.04	281.1	421.89	535.88	558.84	527.69	439.22	329.67	202.04	110.47	74.08	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	414.7	494.05	592.33	714.52	809.8	814.55	771.83	689.21	589.39	480.55	410.49	390.21	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.89	0.71	0.51	0.37	0.43	0.72	0.95	0.99	1	(86)

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

(87)m=	19.89	20.07	20.37	20.73	20.93	20.99	21	21	20.95	20.64	20.19	19.86	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.04	20.03	20.02	20.01	20.01	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.96	0.86	0.65	0.43	0.29	0.34	0.64	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=	18.52	18.79	19.23	19.72	19.96	20.03	20.03	20.03	19.99	19.61	18.98	18.49	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.42 (91)

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

(92)m=	19.09	19.32	19.7	20.14	20.36	20.43	20.43	20.43	20.39	20.04	19.48	19.06	(92)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	18.94	19.17	19.55	19.99	20.21	20.28	20.28	20.28	20.24	19.89	19.33	18.91	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.96	0.86	0.66	0.45	0.31	0.37	0.66	0.93	0.99	1	(94)

DER WorkSheet: New dwelling design stage

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

(95)m=	412.16	486.73	566.06	611.35	538.16	369.3	241.25	253.21	386.21	445.15	405.06	388.42	(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=	997.92	970.14	884.56	740.7	566.92	372.36	241.58	253.96	405.1	618.39	819.42	990.83	(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=	435.8	324.85	236.97	93.13	21.4	0	0	0	0	128.89	298.34	448.19	
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} = 1987.58 (98)

Space heating requirement in kWh/m²/year

32.16 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.5 (206)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

435.8	324.85	236.97	93.13	21.4	0	0	0	0	128.89	298.34	448.19
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(211)m = [(98)m x (204)] x 100 ÷ (206) (211)

481.55	358.95	261.84	102.91	23.65	0	0	0	0	142.42	329.66	495.23
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Total (kWh/year) = Sum(211)_{1...5,10...12} = 2196.22 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

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

Water heating

Output from water heater (calculated above)

180.74	157.88	164.26	145.69	141.06	124.24	119.03	132.69	134.15	152.76	163.07	176.49
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Efficiency of water heater 81.2 (216)

(217)m= (217)

87.56	87.23	86.45	84.59	82.31	81.2	81.2	81.2	81.2	85.21	86.98	87.66
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Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	206.42	180.99	190.02	172.24	171.37	153	146.59	163.41	165.21	179.28	187.48	201.33	
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Total = Sum(219a)_{1...12} = 2117.33 (219)

Annual totals

Space heating fuel used, main system 1

2196.22

Water heating fuel used

2117.33

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

133.45 (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) =	208.45	(231)
Electricity for lighting		279.4	(232)
Electricity generated by PVs		-535.96	(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	=	474.38	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	457.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			931.73	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	108.19	(267)
Electricity for lighting	(232) x	0.519	=	145.01	(268)
Energy saving/generation technologies Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		906.76	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		14.67	(273)
El rating (section 14)				89	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: F-TF-3B (East)

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	79.46 (1a)	2.4 (2a)	190.7 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	79.46 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	190.7 (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
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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) =

75.65 (23c)

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

(24a)m= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (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= 0.29 0.29 0.29 0.27 0.27 0.25 0.25 0.25 0.26 0.27 0.27 0.28 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2	x 1.8	= 3.6		(26)
Windows Type 1			11.47	x 1/[1/(1.1)+0.04]	= 12.09		(27)
Windows Type 2			1.96	x 1/[1/(1.1)+0.04]	= 2.07		(27)
Windows Type 3			10.5	x 1/[1/(1.1)+0.04]	= 11.06		(27)
Windows Type 4			6.3	x 1/[1/(1.1)+0.04]	= 6.64		(27)
Walls	98.4	32.23	66.17	x 0.16	= 10.59		(29)
Roof	79.46	0	79.46	x 0.11	= 8.74		(30)
Total area of elements, m²			177.86				(31)

* 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) = 54.78 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5347.04 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 26.68 (36)

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

Total fabric heat loss (33) + (36) = 81.46 (37)

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

(38)m= 18.54 18.33 18.12 17.05 16.84 15.77 15.77 15.56 16.2 16.84 17.26 17.69 (38)

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

(39)m= 100 99.79 99.58 98.51 98.3 97.23 97.23 97.02 97.66 98.3 98.72 99.15 (39)

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

98.46 (39)

DER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=	1.26	1.26	1.25	1.24	1.24	1.22	1.22	1.22	1.23	1.24	1.24	1.25		
Average = Sum(40) _{1...12} /12=													1.24	(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

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

if TFA ≤ 13.9, N = 1

2.45 (42)

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

92.45 (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 $V_{d,m}$ = factor from Table 1c x (43)														
(44)m=	101.69	97.99	94.3	90.6	86.9	83.2	83.2	86.9	90.6	94.3	97.99	101.69		
Total = Sum(44) _{1...12} =													1109.37	(44)

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

(45)m=	150.81	131.9	136.11	118.66	113.86	98.25	91.04	104.47	105.72	123.21	134.49	146.05		
Total = Sum(45) _{1...12} =													1454.56	(45)

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

(46)m=	22.62	19.78	20.42	17.8	17.08	14.74	13.66	15.67	15.86	18.48	20.17	21.91		(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) × (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) × (51) × (52) × (53) = 0 (54)

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	50.96	45.1	48.05	44.68	44.28	41.03	42.4	44.28	44.68	48.05	48.33	50.96	(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=	201.77	177	184.16	163.34	158.14	139.28	133.44	148.76	150.4	171.26	182.82	197.01	(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=	201.77	177	184.16	163.34	158.14	139.28	133.44	148.76	150.4	171.26	182.82	197.01	
Output from water heater (annual) _{1...12}												2007.37	(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=	62.88	55.13	57.27	50.62	48.93	42.93	40.87	45.81	46.32	52.98	56.8	61.3	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	------

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	122.63	122.63	122.63	122.63	122.63	122.63	122.63	122.63	122.63	122.63	122.63	122.63	(66)

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

(67)m=	19.46	17.29	14.06	10.64	7.96	6.72	7.26	9.43	12.66	16.08	18.76	20	(67)
--------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	----	------

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

(68)m=	218.31	220.57	214.86	202.71	187.37	172.95	163.32	161.05	166.76	178.92	194.26	208.68	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

(69)m=	35.26	35.26	35.26	35.26	35.26	35.26	35.26	35.26	35.26	35.26	35.26	35.26	(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=	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	-98.1	(71)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water heating gains (Table 5)

(72)m=	84.52	82.04	76.97	70.31	65.76	59.62	54.94	61.57	64.34	71.21	78.89	82.39	(72)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(73)m=	385.08	382.69	368.68	346.45	323.88	302.08	288.3	294.85	306.55	328.99	354.7	373.86	(73)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	-------	--------	------

6. Solar gains:

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

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	6.3	x	10.63	x	0.75	x	0.85	=	29.6	(74)
North	0.9x	0.77	x	6.3	x	20.32	x	0.75	x	0.85	=	56.56	(74)
North	0.9x	0.77	x	6.3	x	34.53	x	0.75	x	0.85	=	96.11	(74)
North	0.9x	0.77	x	6.3	x	55.46	x	0.75	x	0.85	=	154.37	(74)
North	0.9x	0.77	x	6.3	x	74.72	x	0.75	x	0.85	=	207.95	(74)

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North	0.9x	0.77	x	6.3	x	79.99	x	0.75	x	0.85	=	222.62	(74)
North	0.9x	0.77	x	6.3	x	74.68	x	0.75	x	0.85	=	207.84	(74)
North	0.9x	0.77	x	6.3	x	59.25	x	0.75	x	0.85	=	164.9	(74)
North	0.9x	0.77	x	6.3	x	41.52	x	0.75	x	0.85	=	115.55	(74)
North	0.9x	0.77	x	6.3	x	24.19	x	0.75	x	0.85	=	67.33	(74)
North	0.9x	0.77	x	6.3	x	13.12	x	0.75	x	0.85	=	36.51	(74)
North	0.9x	0.77	x	6.3	x	8.86	x	0.75	x	0.85	=	24.67	(74)
East	0.9x	0.77	x	11.47	x	19.64	x	0.75	x	0.85	=	99.52	(76)
East	0.9x	0.77	x	11.47	x	38.42	x	0.75	x	0.85	=	194.69	(76)
East	0.9x	0.77	x	11.47	x	63.27	x	0.75	x	0.85	=	320.62	(76)
East	0.9x	0.77	x	11.47	x	92.28	x	0.75	x	0.85	=	467.61	(76)
East	0.9x	0.77	x	11.47	x	113.09	x	0.75	x	0.85	=	573.08	(76)
East	0.9x	0.77	x	11.47	x	115.77	x	0.75	x	0.85	=	586.64	(76)
East	0.9x	0.77	x	11.47	x	110.22	x	0.75	x	0.85	=	558.51	(76)
East	0.9x	0.77	x	11.47	x	94.68	x	0.75	x	0.85	=	479.75	(76)
East	0.9x	0.77	x	11.47	x	73.59	x	0.75	x	0.85	=	372.9	(76)
East	0.9x	0.77	x	11.47	x	45.59	x	0.75	x	0.85	=	231.01	(76)
East	0.9x	0.77	x	11.47	x	24.49	x	0.75	x	0.85	=	124.09	(76)
East	0.9x	0.77	x	11.47	x	16.15	x	0.75	x	0.85	=	81.84	(76)
South	0.9x	0.54	x	10.5	x	46.75	x	0.75	x	0.85	=	152.09	(78)
South	0.9x	0.54	x	10.5	x	76.57	x	0.75	x	0.85	=	249.09	(78)
South	0.9x	0.54	x	10.5	x	97.53	x	0.75	x	0.85	=	317.29	(78)
South	0.9x	0.54	x	10.5	x	110.23	x	0.75	x	0.85	=	358.61	(78)
South	0.9x	0.54	x	10.5	x	114.87	x	0.75	x	0.85	=	373.69	(78)
South	0.9x	0.54	x	10.5	x	110.55	x	0.75	x	0.85	=	359.63	(78)
South	0.9x	0.54	x	10.5	x	108.01	x	0.75	x	0.85	=	351.38	(78)
South	0.9x	0.54	x	10.5	x	104.89	x	0.75	x	0.85	=	341.24	(78)
South	0.9x	0.54	x	10.5	x	101.89	x	0.75	x	0.85	=	331.45	(78)
South	0.9x	0.54	x	10.5	x	82.59	x	0.75	x	0.85	=	268.66	(78)
South	0.9x	0.54	x	10.5	x	55.42	x	0.75	x	0.85	=	180.28	(78)
South	0.9x	0.54	x	10.5	x	40.4	x	0.75	x	0.85	=	131.42	(78)
West	0.9x	0.54	x	1.96	x	19.64	x	0.75	x	0.85	=	11.93	(80)
West	0.9x	0.54	x	1.96	x	38.42	x	0.75	x	0.85	=	23.33	(80)
West	0.9x	0.54	x	1.96	x	63.27	x	0.75	x	0.85	=	38.42	(80)
West	0.9x	0.54	x	1.96	x	92.28	x	0.75	x	0.85	=	56.04	(80)
West	0.9x	0.54	x	1.96	x	113.09	x	0.75	x	0.85	=	68.68	(80)
West	0.9x	0.54	x	1.96	x	115.77	x	0.75	x	0.85	=	70.3	(80)
West	0.9x	0.54	x	1.96	x	110.22	x	0.75	x	0.85	=	66.93	(80)
West	0.9x	0.54	x	1.96	x	94.68	x	0.75	x	0.85	=	57.49	(80)
West	0.9x	0.54	x	1.96	x	73.59	x	0.75	x	0.85	=	44.69	(80)
West	0.9x	0.54	x	1.96	x	45.59	x	0.75	x	0.85	=	27.68	(80)

DER WorkSheet: New dwelling design stage

West $0.9 \times \boxed{0.54} \times \boxed{1.96} \times \boxed{24.49} \times \boxed{0.75} \times \boxed{0.85} = \boxed{14.87}$ (80)

West $0.9 \times \boxed{0.54} \times \boxed{1.96} \times \boxed{16.15} \times \boxed{0.75} \times \boxed{0.85} = \boxed{9.81}$ (80)

Solar gains in watts, calculated for each month

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

(83)m=

293.14	523.67	772.45	1036.63	1223.4	1239.2	1184.66	1043.38	864.59	594.69	355.76	247.74
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 (83)

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

(84)m=

678.22	906.35	1141.13	1383.09	1547.28	1541.27	1472.97	1338.23	1171.14	923.68	710.45	621.61
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 (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
0.99	0.97	0.91	0.76	0.57	0.4	0.29	0.33	0.56	0.86	0.98	0.99

 (86)

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

(87)m=

19.84	20.16	20.52	20.83	20.96	20.99	21	21	20.98	20.74	20.21	19.78
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 (87)

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

(88)m=

19.87	19.88	19.88	19.89	19.89	19.9	19.9	19.9	19.9	19.89	19.89	19.88
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 (88)

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

(89)m=

0.99	0.96	0.88	0.71	0.51	0.33	0.22	0.25	0.48	0.82	0.97	0.99
------	------	------	------	------	------	------	------	------	------	------	------

 (89)

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

(90)m=

18.37	18.82	19.32	19.72	19.86	19.9	19.9	19.9	19.88	19.63	18.91	18.29
-------	-------	-------	-------	-------	------	------	------	-------	-------	-------	-------

 (90)

fLA = Living area ÷ (4) =

0.35

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

(92)m=

18.89	19.29	19.75	20.11	20.25	20.28	20.29	20.29	20.27	20.02	19.37	18.81
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (92)

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

(93)m=

18.74	19.14	19.6	19.96	20.1	20.13	20.14	20.14	20.12	19.87	19.22	18.66
-------	-------	------	-------	------	-------	-------	-------	-------	-------	-------	-------

 (93)

8. Space heating requirement

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

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

(94)m=

0.98	0.95	0.87	0.72	0.52	0.35	0.23	0.27	0.49	0.82	0.96	0.99
------	------	------	------	------	------	------	------	------	------	------	------

 (94)

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

(95)m=

667.58	863.08	998.01	989.51	805.42	535.81	343.73	362.21	576.41	757.56	684.57	614.68
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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
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 (96)

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

(97)m=

1443.81	1420.74	1304.12	1089.92	825.53	538.1	343.98	362.71	587.55	911.11	1196.45	1434.06
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 (97)

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

(98)m=

577.51	374.75	227.75	72.3	14.97	0	0	0	0	114.24	368.55	609.62
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Total per year (kWh/year) = Sum(98)_{1...5,9...12} =

2359.68

Space heating requirement in kWh/m²/year

29.7

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

DER WorkSheet: New dwelling design stage

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		90.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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

Space heating requirement (calculated above)

577.51	374.75	227.75	72.3	14.97	0	0	0	0	114.24	368.55	609.62
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(211)m = {[[(98)m × (204)] } × 100 ÷ (206)

638.13	414.09	251.65	79.88	16.54	0	0	0	0	126.23	407.24	673.61
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Total (kWh/year) = Sum(211)_{1..5,10...12} =

2607.38 (211)

Space heating fuel (secondary), kWh/month

= {[[(98)m × (201)] } × 100 ÷ (208)

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)

201.77	177	184.16	163.34	158.14	139.28	133.44	148.76	150.4	171.26	182.82	197.01
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Efficiency of water heater

81.2 (216)

87.89	87.29	86.09	83.84	81.93	81.2	81.2	81.2	81.2	84.68	87.19	88.04
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Fuel for water heating, kWh/month

(219)m = (64)m × 100 ÷ (217)m

229.56	202.77	213.91	194.81	193.02	171.53	164.34	183.2	185.22	202.24	209.68	223.78
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------

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

2374.06 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

2607.38

Water heating fuel used

2374.06

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside

171.59

(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) =

246.59 (231)

Electricity for lighting

343.71 (232)

Electricity generated by PVs

-535.96 (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) ×	0.216	= 563.19 (261)
Space heating (secondary)	(215) ×	0.519	= 0 (263)
Water heating	(219) ×	0.216	= 512.8 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1075.99 (265)

DER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	127.98	(267)
Electricity for lighting	(232) x	0.519	=	178.39	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-278.16	(269)
Total CO2, kg/year		sum of (265)...(271) =		1104.19	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		13.9	(273)
EI rating (section 14)				88	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Sam Wallis **Stroma Number:** STRO029754
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.25

Property Address: M-GF-3B

Address : New Residential Development, 43 London Street, READING, RG1 4PS

1. Overall dwelling dimensions:

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	22.91 (1a)	x	2.7 (2a)	=	61.86 (3a)
First floor	71.22 (1b)	x	2.4 (2b)	=	170.93 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.13 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	232.79 (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			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			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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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

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

0.5 (23b)

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

73.95 (23c)

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

(24a)m=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.28	0.29
---------	-----	-----	-----	------	------	------	------	------	------	------	------	------

(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=	0.3	0.3	0.3	0.28	0.28	0.26	0.26	0.26	0.27	0.28	0.28	0.29
--------	-----	-----	-----	------	------	------	------	------	------	------	------	------

(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	1.8	3.6		(26)
Windows Type 1			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 2			5.88	$\times 1/[1/(1.1) + 0.04]$	6.2		(27)
Windows Type 3			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Windows Type 4			2	$\times 1/[1/(1.1) + 0.04]$	2.11		(27)
Floor Type 1			22.91	0.12	2.7492		(28)
Floor Type 2			48.31	0.12	5.7972		(28)
Walls	121	13.88	107.12	0.16	17.14		(29)
Total area of elements, m²			192.22				(31)
Party wall			37.46	0	0		(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 41.8 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 19453.2 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 28.83 (36)

DER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 70.64 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.29	23.03	22.77	21.47	21.21	19.9	19.9	19.64	20.42	21.21	21.73	22.25	(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=	93.93	93.66	93.4	92.1	91.84	90.54	90.54	90.28	91.06	91.84	92.36	92.88	
Average = Sum(39) _{1...12} / 12 =												92.04	(39)

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

	1	1	0.99	0.98	0.98	0.96	0.96	0.96	0.97	0.98	0.98	0.99	
(40)m=													
Average = Sum(40) _{1...12} / 12 =												0.98	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N 2.68 (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 97.81 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	107.59	103.67	99.76	95.85	91.94	88.03	88.03	91.94	95.85	99.76	103.67	107.59	
Total = Sum(44) _{1...12} =												1173.67	(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)

	159.55	139.54	143.99	125.54	120.46	103.94	96.32	110.53	111.85	130.35	142.29	154.51	
(45)m=													
Total = Sum(45) _{1...12} =												1538.87	(45)

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

	23.93	20.93	21.6	18.83	18.07	15.59	14.45	16.58	16.78	19.55	21.34	23.18	
(46)m=													(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 × [(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=

50.96	46.03	50.84	47.27	46.85	43.41	44.86	46.85	47.27	50.84	49.32	50.96
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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=

210.51	185.57	194.83	172.81	167.31	147.35	141.18	157.38	159.12	181.19	191.6	205.47
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

 (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=

210.51	185.57	194.83	172.81	167.31	147.35	141.18	157.38	159.12	181.19	191.6	205.47
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

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

2114.31

 (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=

65.79	57.9	60.59	53.56	51.76	45.41	43.24	48.46	49.01	56.05	59.64	64.12
-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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
133.91	133.91	133.91	133.91	133.91	133.91	133.91	133.91	133.91	133.91	133.91	133.91

 (66)

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

(67)m=

23.97	21.29	17.31	13.11	9.8	8.27	8.94	11.62	15.59	19.8	23.11	24.64
-------	-------	-------	-------	-----	------	------	-------	-------	------	-------	-------

 (67)

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

(68)m=

246.47	249.03	242.59	228.87	211.55	195.27	184.39	181.83	188.28	202	219.32	235.6
--------	--------	--------	--------	--------	--------	--------	--------	--------	-----	--------	-------

 (68)

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

(69)m=

36.39	36.39	36.39	36.39	36.39	36.39	36.39	36.39	36.39	36.39	36.39	36.39
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (69)

Pumps and fans gains (Table 5a)

(70)m=

3	3	3	3	3	3	3	3	3	3	3	3
---	---	---	---	---	---	---	---	---	---	---	---

 (70)

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

(71)m=

-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13	-107.13
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

 (71)

Water heating gains (Table 5)

(72)m=

88.43	86.17	81.43	74.39	69.58	63.07	58.12	65.14	68.06	75.34	82.83	86.18
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (72)

Total internal gains =

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

(73)m=

425.04	422.66	407.51	382.53	357.09	332.79	317.62	324.76	338.11	363.31	391.44	412.58
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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)	
North	0.9x	0.77	x	5.88	x	10.63	x	0.75	x	0.85	=	27.62 (74)
North	0.9x	0.77	x	5.88	x	20.32	x	0.75	x	0.85	=	52.79 (74)
North	0.9x	0.77	x	5.88	x	34.53	x	0.75	x	0.85	=	89.7 (74)
North	0.9x	0.77	x	5.88	x	55.46	x	0.75	x	0.85	=	144.08 (74)
North	0.9x	0.77	x	5.88	x	74.72	x	0.75	x	0.85	=	194.09 (74)
North	0.9x	0.77	x	5.88	x	79.99	x	0.75	x	0.85	=	207.78 (74)
North	0.9x	0.77	x	5.88	x	74.68	x	0.75	x	0.85	=	193.99 (74)
North	0.9x	0.77	x	5.88	x	59.25	x	0.75	x	0.85	=	153.9 (74)
North	0.9x	0.77	x	5.88	x	41.52	x	0.75	x	0.85	=	107.85 (74)
North	0.9x	0.77	x	5.88	x	24.19	x	0.75	x	0.85	=	62.84 (74)
North	0.9x	0.77	x	5.88	x	13.12	x	0.75	x	0.85	=	34.08 (74)
North	0.9x	0.77	x	5.88	x	8.86	x	0.75	x	0.85	=	23.03 (74)
Northeast	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97 (75)
Northeast	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29 (75)
Northeast	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56 (75)
Northeast	0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04 (75)
Northeast	0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71 (75)
Northeast	0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05 (75)
Northeast	0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49 (75)
Northeast	0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17 (75)
Northeast	0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55 (75)
Northeast	0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8 (75)
Northeast	0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54 (75)
Northeast	0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14 (75)
South	0.9x	0.54	x	2	x	46.75	x	0.75	x	0.85	=	28.97 (78)
South	0.9x	0.54	x	2	x	76.57	x	0.75	x	0.85	=	47.45 (78)
South	0.9x	0.54	x	2	x	97.53	x	0.75	x	0.85	=	60.44 (78)
South	0.9x	0.54	x	2	x	110.23	x	0.75	x	0.85	=	68.31 (78)
South	0.9x	0.54	x	2	x	114.87	x	0.75	x	0.85	=	71.18 (78)
South	0.9x	0.54	x	2	x	110.55	x	0.75	x	0.85	=	68.5 (78)
South	0.9x	0.54	x	2	x	108.01	x	0.75	x	0.85	=	66.93 (78)
South	0.9x	0.54	x	2	x	104.89	x	0.75	x	0.85	=	65 (78)
South	0.9x	0.54	x	2	x	101.89	x	0.75	x	0.85	=	63.13 (78)
South	0.9x	0.54	x	2	x	82.59	x	0.75	x	0.85	=	51.17 (78)
South	0.9x	0.54	x	2	x	55.42	x	0.75	x	0.85	=	34.34 (78)
South	0.9x	0.54	x	2	x	40.4	x	0.75	x	0.85	=	25.03 (78)
Northwest	0.9x	0.77	x	2	x	11.28	x	0.75	x	0.85	=	9.97 (81)
Northwest	0.9x	0.77	x	2	x	22.97	x	0.75	x	0.85	=	20.29 (81)
Northwest	0.9x	0.77	x	2	x	41.38	x	0.75	x	0.85	=	36.56 (81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	2	x	67.96	x	0.75	x	0.85	=	60.04	(81)
Northwest 0.9x	0.77	x	2	x	91.35	x	0.75	x	0.85	=	80.71	(81)
Northwest 0.9x	0.77	x	2	x	97.38	x	0.75	x	0.85	=	86.05	(81)
Northwest 0.9x	0.77	x	2	x	91.1	x	0.75	x	0.85	=	80.49	(81)
Northwest 0.9x	0.77	x	2	x	72.63	x	0.75	x	0.85	=	64.17	(81)
Northwest 0.9x	0.77	x	2	x	50.42	x	0.75	x	0.85	=	44.55	(81)
Northwest 0.9x	0.77	x	2	x	28.07	x	0.75	x	0.85	=	24.8	(81)
Northwest 0.9x	0.77	x	2	x	14.2	x	0.75	x	0.85	=	12.54	(81)
Northwest 0.9x	0.77	x	2	x	9.21	x	0.75	x	0.85	=	8.14	(81)

Solar gains in watts, calculated for each month

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

(83)m=	76.53	140.82	223.26	332.48	426.69	448.37	421.91	347.25	260.08	163.61	93.5	64.34	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	501.57	563.48	630.77	715.01	783.78	781.16	739.53	672.01	598.19	526.92	484.94	476.93	(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	1	0.99	0.97	0.89	0.7	0.53	0.6	0.87	0.99	1	1	(86)

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

(87)m=	19.9	20.03	20.25	20.57	20.84	20.97	20.99	20.99	20.89	20.55	20.18	19.89	(87)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(88)m=	20.09	20.09	20.09	20.1	20.1	20.12	20.12	20.12	20.11	20.1	20.1	20.09	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	------	-------	------

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

(89)m=	1	1	0.99	0.96	0.85	0.62	0.43	0.5	0.81	0.98	1	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.61	18.79	19.12	19.58	19.94	20.09	20.11	20.11	20.02	19.56	19.02	18.59	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.33 (91)

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

(92)m=	19.04	19.2	19.49	19.91	20.24	20.38	20.41	20.4	20.31	19.89	19.4	19.02	(92)
--------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	------	-------	------

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

(93)m=	18.89	19.05	19.34	19.76	20.09	20.23	20.26	20.25	20.16	19.74	19.25	18.87	(93)
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8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.95	0.84	0.63	0.45	0.51	0.82	0.97	1	1	(94)
--------	---	---	------	------	------	------	------	------	------	------	---	---	------

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

(95)m=	500.47	560.9	622.82	681.72	661.63	494.34	329.21	344.21	488.05	512.8	482.66	476.14	(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=	1370.2	1325.55	1199.75	999.88	770.12	510.06	330.92	347.87	551.51	839.46	1122.31	1362.39	(97)
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DER WorkSheet: New dwelling design stage

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

(98)m=	647.08	513.84	429.23	229.08	80.72	0	0	0	0	243.04	460.55	659.37	
Total per year (kWh/year) = Sum(98) _{1...5,9...12} =													3262.91 (98)

Space heating requirement in kWh/m ² /year	34.66 (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) × [1 – (203)] =	1 (204)
Efficiency of main space heating system 1	90.5 (206)
Efficiency of secondary/supplementary heating system, %	0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
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Space heating requirement (calculated above)

647.08	513.84	429.23	229.08	80.72	0	0	0	0	243.04	460.55	659.37
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

715	567.78	474.29	253.12	89.19	0	0	0	0	268.55	508.9	728.59		
Total (kWh/year) =Sum(211) _{1...5,10...12} =												3605.42	(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)

210.51	185.57	194.83	172.81	167.31	147.35	141.18	157.38	159.12	181.19	191.6	205.47
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Efficiency of water heater 81.2 (216)

(217)m=	88.03	87.83	87.38	86.25	84.01	81.2	81.2	81.2	81.2	86.28	87.55	88.1	(217)
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Fuel for water heating, kWh/month

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

(219)m=	239.14	211.28	222.98	200.35	199.15	181.47	173.86	193.82	195.96	210	218.84	233.22	
Total = Sum(219a) _{1...12} =													2480.07 (219)

Annual totals

Space heating fuel used, main system 1	3605.42
Water heating fuel used	2480.07

Electricity for pumps, fans and electric keep-hot

mechanical ventilation - balanced, extract or positive input from outside	273.35 (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) = 348.35 (231)

Electricity for lighting 423.34 (232)

Electricity generated by PVs -535.96 (233)

DER WorkSheet: New dwelling design stage

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	=	778.77 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.216	=	535.69 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1314.47 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	180.79 (267)
Electricity for lighting	(232) x	0.519	=	219.71 (268)
Energy saving/generation technologies Item 1		0.519	=	-278.16 (269)
Total CO2, kg/year	sum of (265)...(271) =			1436.81 (272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			15.26 (273)
El rating (section 14)				86 (274)