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Energy Statement
34A-36 Kilburn High Road

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About the scheme:

The project consists of the construction of a new 5th floor level on top of an existing building, to create 5 new residential units. The development is located in in the London Borough of Camden area and it has a total net internal area of 470 m^2.

Planning policy

In accordance with the Appeal Decision, the scheme is required to achieve a 35% overall improvement over Part L Building Regulations 2013 with regards to carbon dioxide emissions reduction targets and 20% carbon reduction from renewable sources. An energy assessment was produced by Eight Associates on 30/04/2018.

The strategy included the use of gas boilers. However, the council has asked for a zero-emission heating system and therefore, a design option with ASHPs will be investigated in this report.

Aim of this study:

The purpose of an energy statement is to demonstrate that climate change mitigation measures comply with London Plan energy policies. It also ensures energy remains an integral part of the development's design and evolution.

The Energy Statement is a revision to the Energy Assessment carried out previously by Eight Associates dated May 2018.

Carbon dioxide emissions reduction

	Baseline	Lean	Green
CO_2 emissions (Tonnes CO_2/yr)	6.78	6.31	4.26
CO_2 emissions saving (Tonnes CO_2/yr)	-	0.47	2.05
Saving from each stage (%)	-	7.00	30.20
Total CO_2 emissions saving (Tonnes CO_2/yr)		2.52	
Total CO_2 emissions saving (%)		37.10	

As demonstrated above, the scheme achieves a 37.1% carbon emission reduction over Part L1A 2013 building regulations. The development has applied the 'fabric first' approach and specified superior building fabric properties, followed by energy efficient systems and incorporation of renewable energy technologies, to achieve the required savings over building regulations.

The design parameters have been elaborated on in the next section.

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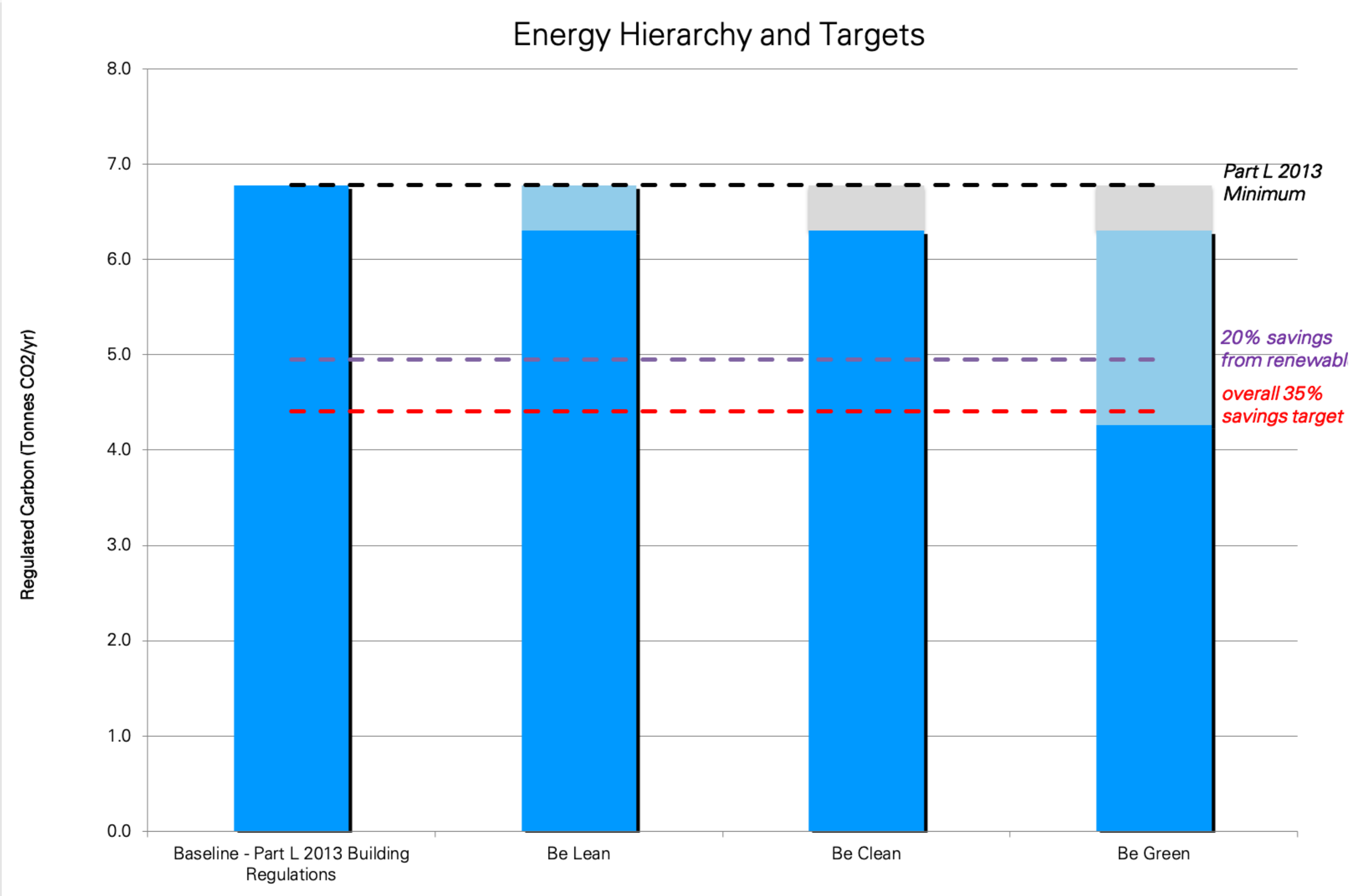
GLA's Energy Hierarchy – Regulated Carbon Emissions:

A graphical illustration of how the scheme performs in relation to Building Regulations and the Energy Hierarchy is shown below.

Figure



Summary:

As demonstrated above the development will reduce carbon emissions by 7.0% from the fabric energy efficiency measures described in the 'Be Lean' section, and will reduce total carbon emissions by 37.1% over Building Regulations with the further inclusion of low and zero carbon technologies (communal ASHP and photovoltaic panels).

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Establishing Emissions
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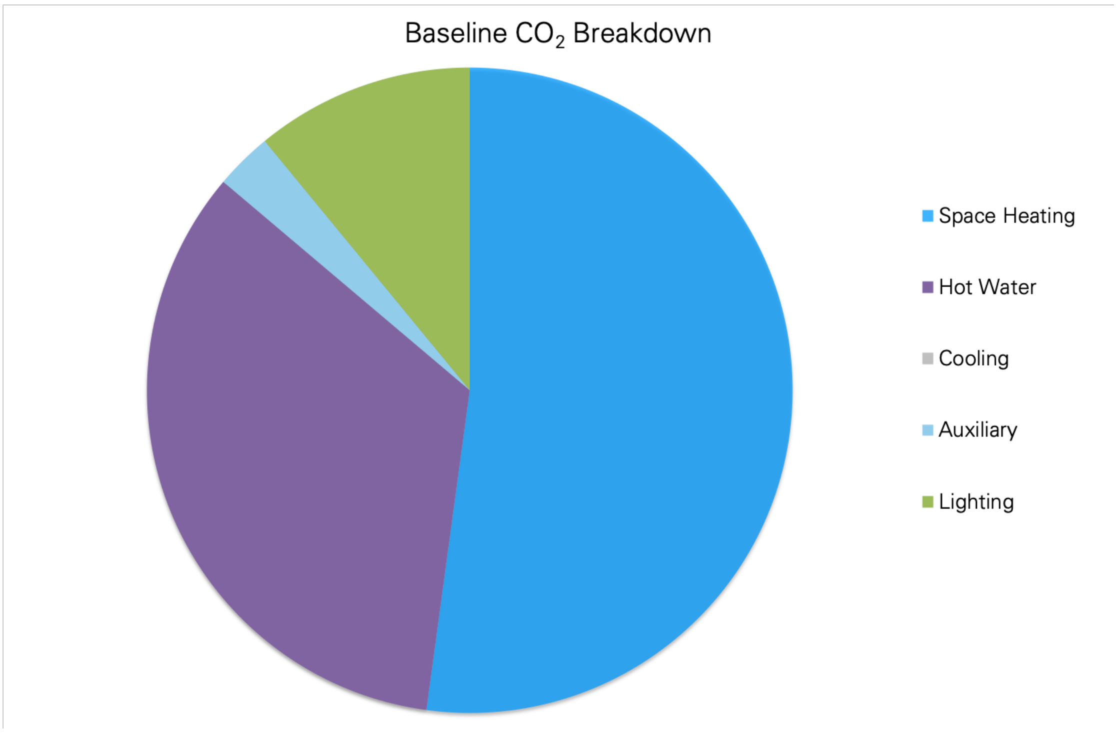
Building Regulations Part L 2013 Minimum Compliance:

The 'baseline' carbon dioxide emissions for the development are 6.78 Tonnes CO_2/yr.

The pie chart below provides a breakdown of the scheme's baseline carbon emissions by system over the course of one year.

Carbon Emissions in Tonnes CO_2/yr	Heating	Hot Water	Cooling	Auxiliary	Lighting
	3.54	2.31	0.00	0.19	0.74



Overview:

The chart above shows that space heating is the primary source of carbon emissions, and hot water is the second largest. Therefore, emphasis must be placed on reducing the heating demand for the dwellings.

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SAP Inputs
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Building fabric

Building element	Minimum Building Regulations U value W/m²K	Proposed U-Value, W/m²K
External Walls	0.30	0.15
Corridor Walls	0.30	0.15
Party Walls	0.20	0.00
Roofs	0.20	0.10
Windows (g-value 0.55)	2.00	1.30
Rooflights (g-value 0.55)	2.00	1.60
Doors	2.00	1.30

Air tightness

The target air permeability for the scheme has been modelled as 3 $m^3/(hr.m^2)$ @ 50 pa.

This will require careful attention to two key areas:

- Structural leakage
- Services leakage

Structural leakage occurs at joints in the building fabric and around window and door openings, loft hatches and access openings. There will also be some diffusion through materials such and cracks in masonry walls typically caused by poor perpends in blockwork inner leafs. Structural leakage is hard to remedy retrospectively therefore good detailing at the design stage is essential.

Services leakage occurs at penetrations from pipes and cables entering the building. These can be sewerage pipes, water pipes and heating pipes. As well as electricity cables there may also be telecommunication cables. Attention therefore, needs to be paid to sealing all penetrations during construction.

Thermal bridging

The scheme will be designed in line with the accredited construction details (ACD) and therefore it has been indicatively modelled with the accredited thermal bridge Psi-values for the following junctions:

- Lintels (E2)
- Sill (E3)
- Jambs (E4)
- Corners (E16)
- Inverted corners (E17)
- Party walls between dwellings (E18)

In addition, a bespoke calculation should be performed for the following junction:

- Inverted eave (E24) to target a psi-value of 0.15 W/mK

The default psi-value has been used for the remaining junctions.

Thermal mass

Thermal mass of the scheme has been indicatively modelled as 250 kJ/m^2K (medium).

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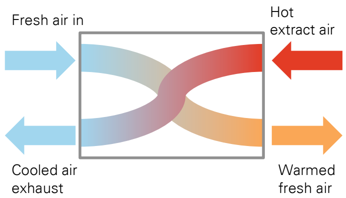
Energy efficient services



Graphic illustration of a heat recovery unit, which exploits the extract hot air of the room to heat the cold supply air.

Heating:
For the Be Lean scenario, heating is provided by individual gas boilers with 89.5% efficiency and transmitted via radiators featuring time and temperature zone control by suitable arrangement of plumbing and electrical services and delayed thermostat.

For the Be Green scenario, a communal air source heat pump system with a COP of more than 3.0 has been specified where the charging system is linked to the use of a community heating programmer and at least two room thermostats. The heat will be distributed via underfloor heating.

Ventilation:
Balanced mechanical ventilation with heat recovery will be provided to dwellings and wet rooms. Apartments 1-4 with 1 wet room have a specific fan power of 0.53W/l/s and a heat recovery of 89%. Apartment 5 with 2 wet rooms has a specific fan power of 0.60W/l/s and a heat recovery of 88%.

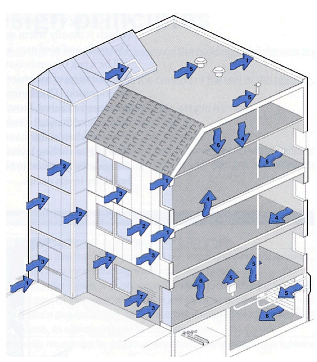
Hot water:
For the Be Lean scenario, hot water will be provided by the gas boiler with an efficiency of 89.5%.

For the Be Green scenario, 70% of the hot water will be provided by the communal ASHP with a supplementary immersion heater for the remaining 30% of hot water demand.

Air conditioning:
No cooling system has been specified for the dwellings. Natural ventilation through openable windows will be used as a passive cooling measure.

Lighting:
High efficiency lighting has been specified for the development with a luminaire efficacy of more than 70 lumens/watt.

Overheating



Possible air leakage points in a building

Natural ventilation:
Openable windows are specified on all facades of the building. Cross ventilation will be achieved by opening windows on two facades and ensuring there is a clear path for airflow. Internal heat gains have been minimised where possible. Energy efficient appliances will help reduce internal heat gain and reduce overheating risk. Energy efficient lighting will also be specified to achieve low power densities.

Heat transfer and infiltration has been controlled in the following ways:

- Insulation levels have been maximised and the resulting u-values are lower than required by Building Regulations. The build-ups therefore prevent the penetration of heat as much as practically possible.
- A reduced air permeability rate of 3 $m^3/(hr.m^2)$ @ 50 pa has been targeted to minimise uncontrolled air infiltration. This will require attention to detailing and sealing.

Renewable energy technology

A photovoltaic panel system of 4.5 kWp (approximately 15PV panels of 300W each in total) has been specified for the development. PV panels will be oriented Southeast, with 10° tilt covering approximately 30m^2 of the roof.

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SAP Worksheets
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SAP Worksheets

Be Lean Block Compliance
Be Green Block Compliance

Block Compliance WorkSheet: 34A-36 Kilburn High Road

User Details

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP	**Software Version:**	Version: 1.0.4.16

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Apartment 1	23.14	23.63	67.3	68.4	50.17
Apartment 2	21.06	22.53	60.7	66.7	59.25
Apartment 3	17.56	19.57	49.6	56.6	72.85
Apartment 4	20.66	21.91	59.8	64.3	61.4
Apartment 5	17.9	19.75	49.9	58.5	75.4

Calculation Summary

Total Floor Area	319.07
Average TER	21.25
Average DER	19.76
Average DFEE	56.48
Average TFEE	62.26
Compliance	Pass
% Improvement DER|TER	7.01
% Improvement DFEE|TFEE	9.28

Block Compliance WorkSheet: 34A-36 Kilburn High Road

User Details

Assessor Name: Chris Hocknell
Stroma Number: STRO016363
Software Name: Stroma FSAP
Software Version: Version: 1.0.4.16

Calculation Details

Dwelling	DER	TER	DFEE	TFEE	TFA
Apartment 1	15.15	34.66	67.3	68.4	50.17
Apartment 2	14.09	32.84	60.7	66.7	59.25
Apartment 3	12.02	28.26	49.6	56.6	72.85
Apartment 4	13.96	31.89	59.8	64.3	61.4
Apartment 5	12.39	28.51	49.9	58.5	75.4

Calculation Summary

Total Floor Area	319.07
Average TER	30.87
Average DER	13.36
Average DFEE	56.48
Average TFEE	62.26
Compliance % Improvement DER|TER % Improvement DFEE|TFEE	Pass 56.72 9.28

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SAP Worksheets
Energy Statement
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SAP Worksheets

TFEE and DFEE Worksheets

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.17	(1a) x	2.7	(2a) =	135.46	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.17	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.46	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

TFEE WorkSheet: New dwelling design stage

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

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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	=	2			(26)
Windows Type 1			3.97	x1/[1/(1.4)+ 0.04]		=	5.26			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			1.73	x1/[1/(1.4)+ 0.04]		=	2.29			(27)
Rooflights Type 1			0.4364994	x1/[1/(1.7) + 0.04]		=	0.7420489			(27b)
Rooflights Type 2			0.7441275	x1/[1/(1.7) + 0.04]		=	1.265017			(27b)
Walls Type1	35.48	9.35	26.13	x	0.18	=	4.7			(29)
Walls Type2	30.48	2	28.48	x	0.18	=	5.13			(29)
Roof	50.17	1.18	48.99	x	0.13	=	6.37			(30)
Total area of elements, m²			116.13							(31)
Party wall			26.97	x	0	=	0			(32)
Party floor			50.17							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13363 (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 11.14 (36)

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

TFEE WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	43.61	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.27	27.08	26.89	26.01	25.85	25.08	25.08	24.94	25.37	25.85	26.18	26.53	(38)

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

(39)m=	70.88	70.68	70.5	69.62	69.45	68.69	68.69	68.55	68.98	69.45	69.79	70.13	

Average = Sum(39)$_{1...12}$ /12= 69.62 (39)

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

(40)m=	1.41	1.41	1.41	1.39	1.38	1.37	1.37	1.37	1.37	1.38	1.39	1.4	

Average = Sum(40)$_{1...12}$ /12= 1.39 (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 1.7 (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 74.46 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.9	78.93	75.95	72.97	69.99	67.01	67.01	69.99	72.97	75.95	78.93	81.9	

Total = Sum(44)$_{1...12}$ = 893.51 (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=	121.46	106.23	109.62	95.57	91.7	79.13	73.33	84.14	85.15	99.23	108.32	117.63	

Total = Sum(45)$_{1...12}$ = 1171.53 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
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)

TFEE WorkSheet: New dwelling design stage

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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

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

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

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

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

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

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

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

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

(62)m=	103.24	90.3	93.18	81.24	77.95	67.26	62.33	71.52	72.38	84.35	92.07	99.99	(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=	103.24	90.3	93.18	81.24	77.95	67.26	62.33	71.52	72.38	84.35	92.07	99.99

Output from water heater (annual)$_{1...12}$ — 995.8 — (64)

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

(65)m=	25.81	22.57	23.29	20.31	19.49	16.82	15.58	17.88	18.09	21.09	23.02	25	(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=	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	(66)

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

(67)m=	13.18	11.71	9.52	7.21	5.39	4.55	4.92	6.39	8.58	10.89	12.71	13.55	(67)

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

(68)m=	147.68	149.21	145.35	137.13	126.75	116.99	110.48	108.95	112.81	121.03	131.41	141.16	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	(71)

Water heating gains (Table 5)

(72)m=	34.69	33.59	31.31	28.21	26.19	23.35	20.94	24.03	25.13	28.34	31.97	33.6	(72)

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

(73)m=	243.98	242.94	234.61	220.97	206.76	193.33	184.77	187.8	194.94	208.69	224.51	236.73	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.97	x	11.28	x	0.63	x	0.7	=	13.69	(75)
Northeast	0.9x	0.77	x	1.92	x	11.28	x	0.63	x	0.7	=	6.62	(75)
Northeast	0.9x	0.77	x	3.97	x	22.97	x	0.63	x	0.7	=	27.87	(75)
Northeast	0.9x	0.77	x	1.92	x	22.97	x	0.63	x	0.7	=	13.48	(75)
Northeast	0.9x	0.77	x	3.97	x	41.38	x	0.63	x	0.7	=	50.2	(75)
Northeast	0.9x	0.77	x	1.92	x	41.38	x	0.63	x	0.7	=	24.28	(75)
Northeast	0.9x	0.77	x	3.97	x	67.96	x	0.63	x	0.7	=	82.45	(75)
Northeast	0.9x	0.77	x	1.92	x	67.96	x	0.63	x	0.7	=	39.87	(75)
Northeast	0.9x	0.77	x	3.97	x	91.35	x	0.63	x	0.7	=	110.83	(75)
Northeast	0.9x	0.77	x	1.92	x	91.35	x	0.63	x	0.7	=	53.6	(75)
Northeast	0.9x	0.77	x	3.97	x	97.38	x	0.63	x	0.7	=	118.15	(75)
Northeast	0.9x	0.77	x	1.92	x	97.38	x	0.63	x	0.7	=	57.14	(75)
Northeast	0.9x	0.77	x	3.97	x	91.1	x	0.63	x	0.7	=	110.53	(75)
Northeast	0.9x	0.77	x	1.92	x	91.1	x	0.63	x	0.7	=	53.46	(75)
Northeast	0.9x	0.77	x	3.97	x	72.63	x	0.63	x	0.7	=	88.12	(75)
Northeast	0.9x	0.77	x	1.92	x	72.63	x	0.63	x	0.7	=	42.62	(75)
Northeast	0.9x	0.77	x	3.97	x	50.42	x	0.63	x	0.7	=	61.17	(75)
Northeast	0.9x	0.77	x	1.92	x	50.42	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	3.97	x	28.07	x	0.63	x	0.7	=	34.05	(75)
Northeast	0.9x	0.77	x	1.92	x	28.07	x	0.63	x	0.7	=	16.47	(75)
Northeast	0.9x	0.77	x	3.97	x	14.2	x	0.63	x	0.7	=	17.22	(75)
Northeast	0.9x	0.77	x	1.92	x	14.2	x	0.63	x	0.7	=	8.33	(75)
Northeast	0.9x	0.77	x	3.97	x	9.21	x	0.63	x	0.7	=	11.18	(75)
Northeast	0.9x	0.77	x	1.92	x	9.21	x	0.63	x	0.7	=	5.41	(75)
Northwest	0.9x	0.77	x	1.73	x	11.28	x	0.63	x	0.7	=	11.93	(81)
Northwest	0.9x	0.77	x	1.73	x	22.97	x	0.63	x	0.7	=	24.29	(81)
Northwest	0.9x	0.77	x	1.73	x	41.38	x	0.63	x	0.7	=	43.75	(81)
Northwest	0.9x	0.77	x	1.73	x	67.96	x	0.63	x	0.7	=	71.86	(81)
Northwest	0.9x	0.77	x	1.73	x	91.35	x	0.63	x	0.7	=	96.59	(81)
Northwest	0.9x	0.77	x	1.73	x	97.38	x	0.63	x	0.7	=	102.98	(81)
Northwest	0.9x	0.77	x	1.73	x	91.1	x	0.63	x	0.7	=	96.33	(81)
Northwest	0.9x	0.77	x	1.73	x	72.63	x	0.63	x	0.7	=	76.8	(81)
Northwest	0.9x	0.77	x	1.73	x	50.42	x	0.63	x	0.7	=	53.32	(81)
Northwest	0.9x	0.77	x	1.73	x	28.07	x	0.63	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	1.73	x	14.2	x	0.63	x	0.7	=	15.01	(81)
Northwest	0.9x	0.77	x	1.73	x	9.21	x	0.63	x	0.7	=	9.74	(81)
Rooflights	0.9x	1	x	0.44	x	26	x	0.63	x	0.7	=	4.5	(82)
Rooflights	0.9x	1	x	0.74	x	26	x	0.63	x	0.7	=	7.68	(82)
Rooflights	0.9x	1	x	0.44	x	54	x	0.63	x	0.7	=	9.36	(82)

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Rooflights 0.9x	1	x	0.74	x	54	x	0.63	x	0.7	=	15.95	(82)
Rooflights 0.9x	1	x	0.44	x	96	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	0.74	x	96	x	0.63	x	0.7	=	28.35	(82)
Rooflights 0.9x	1	x	0.44	x	150	x	0.63	x	0.7	=	25.99	(82)
Rooflights 0.9x	1	x	0.74	x	150	x	0.63	x	0.7	=	44.3	(82)
Rooflights 0.9x	1	x	0.44	x	192	x	0.63	x	0.7	=	33.26	(82)
Rooflights 0.9x	1	x	0.74	x	192	x	0.63	x	0.7	=	56.71	(82)
Rooflights 0.9x	1	x	0.44	x	200	x	0.63	x	0.7	=	34.65	(82)
Rooflights 0.9x	1	x	0.74	x	200	x	0.63	x	0.7	=	59.07	(82)
Rooflights 0.9x	1	x	0.44	x	189	x	0.63	x	0.7	=	32.74	(82)
Rooflights 0.9x	1	x	0.74	x	189	x	0.63	x	0.7	=	55.82	(82)
Rooflights 0.9x	1	x	0.44	x	157	x	0.63	x	0.7	=	27.2	(82)
Rooflights 0.9x	1	x	0.74	x	157	x	0.63	x	0.7	=	46.37	(82)
Rooflights 0.9x	1	x	0.44	x	115	x	0.63	x	0.7	=	19.92	(82)
Rooflights 0.9x	1	x	0.74	x	115	x	0.63	x	0.7	=	33.96	(82)
Rooflights 0.9x	1	x	0.44	x	66	x	0.63	x	0.7	=	11.43	(82)
Rooflights 0.9x	1	x	0.74	x	66	x	0.63	x	0.7	=	19.49	(82)
Rooflights 0.9x	1	x	0.44	x	33	x	0.63	x	0.7	=	5.72	(82)
Rooflights 0.9x	1	x	0.74	x	33	x	0.63	x	0.7	=	9.75	(82)
Rooflights 0.9x	1	x	0.44	x	21	x	0.63	x	0.7	=	3.64	(82)
Rooflights 0.9x	1	x	0.74	x	21	x	0.63	x	0.7	=	6.2	(82)

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

(83)m=	44.42	90.93	163.22	264.47	350.99	371.99	348.88	281.1	197.96	111.13	56.03	36.17	(83)

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

(84)m=	288.4	333.87	397.83	485.44	557.74	565.32	533.65	468.89	392.91	319.82	280.54	272.9	(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	0.96	0.87	0.7	0.55	0.63	0.88	0.98	1	1	(86)

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

(87)m=	19.4	19.56	19.88	20.32	20.71	20.92	20.98	20.96	20.77	20.27	19.76	19.38	(87)

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

(88)m=	19.75	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.76	(88)

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

(89)m=	1	0.99	0.99	0.94	0.82	0.6	0.41	0.48	0.81	0.97	1	1	(89)

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

(90)m=	18.31	18.47	18.79	19.24	19.58	19.75	19.78	19.78	19.65	19.19	18.69	18.3	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.83	18.99	19.3	19.75	20.12	20.31	20.35	20.34	20.18	19.7	19.19	18.81	(92)

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

(93)m=	18.83	18.99	19.3	19.75	20.12	20.31	20.35	20.34	20.18	19.7	19.19	18.81	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.83	0.64	0.47	0.55	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	287.5	331.81	391.15	457.28	463.73	363.85	251.91	259.31	329.73	311.4	278.95	272.24	(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=	1029.53	995.75	902.54	755.38	584.55	391.9	257.49	270.02	419.39	632.05	844.04	1024.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	552.07	446.17	380.48	214.63	89.89	0	0	0	0	238.56	406.86	559.73	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2888.38 (98)

Space heating requirement in kWh/m²/year 57.57 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	645.67	508.29	520.95	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	548.95	461.37	451.53	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	709.09	671.73	599.52	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	115.3	156.5	110.1	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 381.91 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	28.83	39.13	27.53	0	0	0	0

Total = Sum(107)$_{6...8}$ = 95.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.9 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 59.47 (109)

Target Fabric Energy Efficiency (TFEE) 68.4 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.25	(1a) x	2.7	(2a) =	159.98	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	159.98	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

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

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1	=	2			(26)
Windows Type 1			4.89	x1/[1/(1.4)+ 0.04]		=	6.48			(27)
Windows Type 2			2.49	x1/[1/(1.4)+ 0.04]		=	3.3			(27)
Windows Type 3			1.9	x1/[1/(1.4)+ 0.04]		=	2.52			(27)
Windows Type 4			2.58	x1/[1/(1.4)+ 0.04]		=	3.42			(27)
Rooflights			0.9523603	x1/[1/(1.7) + 0.04]		=	1.619012			(27b)
Walls Type1	38.95	11.86	27.09	x	0.18	=	4.88			(29)
Walls Type2	45.47	2	43.47	x	0.18	=	7.82			(29)
Roof	59.25	0.95	58.3	x	0.13	=	7.58			(30)
Total area of elements, m²			143.67							(31)
Party wall			25.95	x	0	=	0			(32)
Party floor			59.25							(32a)

** 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) = 39.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16820.08 (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 11.3 (36)

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

TFEE WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	50.82	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.02	29.88	29.74	29.09	28.97	28.41	28.41	28.3	28.63	28.97	29.22	29.47	(38)

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

(39)m=	80.84	80.7	80.57	79.92	79.8	79.23	79.23	79.13	79.45	79.8	80.04	80.3	

Average = Sum(39)$_{1…12}$ /12= 79.92 (39)

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

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

Average = Sum(40)$_{1…12}$ /12= 1.35 (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 1.96 (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 80.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	88.83	85.6	82.37	79.14	75.91	72.68	72.68	75.91	79.14	82.37	85.6	88.83	

Total = Sum(44)$_{1…12}$ = 969.1 (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=	131.74	115.22	118.9	103.66	99.46	85.83	79.53	91.26	92.35	107.63	117.49	127.58	

Total = Sum(45)$_{1…12}$ = 1270.64 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)			
Water storage loss:			
a) If manufacturer’s declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	111.98	97.94	101.06	88.11	84.54	72.95	67.6	77.57	78.5	91.48	99.86	108.44	(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=	111.98	97.94	101.06	88.11	84.54	72.95	67.6	77.57	78.5	91.48	99.86	108.44

Output from water heater (annual)$_{1...12}$ 1080.05 (64)

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

(65)m=	27.99	24.48	25.27	22.03	21.14	18.24	16.9	19.39	19.63	22.87	24.97	27.11	(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=	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	(66)

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

(67)m=	15.26	13.55	11.02	8.34	6.24	5.26	5.69	7.39	9.92	12.6	14.71	15.68	(67)

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

(68)m=	171.05	172.83	168.35	158.83	146.81	135.51	127.97	126.19	130.66	140.19	152.21	163.5	(68)

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

(69)m=	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	(71)

Water heating gains (Table 5)

(72)m=	37.63	36.43	33.96	30.59	28.41	25.33	22.72	26.07	27.26	30.74	34.67	36.44	(72)

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

(73)m=	276.34	275.22	265.74	250.17	233.86	218.51	208.78	212.06	220.25	235.93	254	268.03	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.49	x	11.28	x	0.63	x	0.7	=	8.59	(75)
Northeast	0.9x	0.77	x	2.49	x	22.97	x	0.63	x	0.7	=	17.48	(75)
Northeast	0.9x	0.77	x	2.49	x	41.38	x	0.63	x	0.7	=	31.49	(75)
Northeast	0.9x	0.77	x	2.49	x	67.96	x	0.63	x	0.7	=	51.71	(75)
Northeast	0.9x	0.77	x	2.49	x	91.35	x	0.63	x	0.7	=	69.51	(75)
Northeast	0.9x	0.77	x	2.49	x	97.38	x	0.63	x	0.7	=	74.11	(75)
Northeast	0.9x	0.77	x	2.49	x	91.1	x	0.63	x	0.7	=	69.33	(75)
Northeast	0.9x	0.77	x	2.49	x	72.63	x	0.63	x	0.7	=	55.27	(75)
Northeast	0.9x	0.77	x	2.49	x	50.42	x	0.63	x	0.7	=	38.37	(75)
Northeast	0.9x	0.77	x	2.49	x	28.07	x	0.63	x	0.7	=	21.36	(75)
Northeast	0.9x	0.77	x	2.49	x	14.2	x	0.63	x	0.7	=	10.8	(75)
Northeast	0.9x	0.77	x	2.49	x	9.21	x	0.63	x	0.7	=	7.01	(75)
Northwest	0.9x	0.77	x	4.89	x	11.28	x	0.63	x	0.7	=	16.86	(81)
Northwest	0.9x	0.77	x	1.9	x	11.28	x	0.63	x	0.7	=	6.55	(81)
Northwest	0.9x	0.77	x	2.58	x	11.28	x	0.63	x	0.7	=	8.9	(81)
Northwest	0.9x	0.77	x	4.89	x	22.97	x	0.63	x	0.7	=	34.32	(81)
Northwest	0.9x	0.77	x	1.9	x	22.97	x	0.63	x	0.7	=	13.34	(81)
Northwest	0.9x	0.77	x	2.58	x	22.97	x	0.63	x	0.7	=	18.11	(81)
Northwest	0.9x	0.77	x	4.89	x	41.38	x	0.63	x	0.7	=	61.84	(81)
Northwest	0.9x	0.77	x	1.9	x	41.38	x	0.63	x	0.7	=	24.03	(81)
Northwest	0.9x	0.77	x	2.58	x	41.38	x	0.63	x	0.7	=	32.63	(81)
Northwest	0.9x	0.77	x	4.89	x	67.96	x	0.63	x	0.7	=	101.56	(81)
Northwest	0.9x	0.77	x	1.9	x	67.96	x	0.63	x	0.7	=	39.46	(81)
Northwest	0.9x	0.77	x	2.58	x	67.96	x	0.63	x	0.7	=	53.58	(81)
Northwest	0.9x	0.77	x	4.89	x	91.35	x	0.63	x	0.7	=	136.51	(81)
Northwest	0.9x	0.77	x	1.9	x	91.35	x	0.63	x	0.7	=	53.04	(81)
Northwest	0.9x	0.77	x	2.58	x	91.35	x	0.63	x	0.7	=	72.02	(81)
Northwest	0.9x	0.77	x	4.89	x	97.38	x	0.63	x	0.7	=	145.54	(81)
Northwest	0.9x	0.77	x	1.9	x	97.38	x	0.63	x	0.7	=	56.55	(81)
Northwest	0.9x	0.77	x	2.58	x	97.38	x	0.63	x	0.7	=	76.79	(81)
Northwest	0.9x	0.77	x	4.89	x	91.1	x	0.63	x	0.7	=	136.15	(81)
Northwest	0.9x	0.77	x	1.9	x	91.1	x	0.63	x	0.7	=	52.9	(81)
Northwest	0.9x	0.77	x	2.58	x	91.1	x	0.63	x	0.7	=	71.83	(81)
Northwest	0.9x	0.77	x	4.89	x	72.63	x	0.63	x	0.7	=	108.54	(81)
Northwest	0.9x	0.77	x	1.9	x	72.63	x	0.63	x	0.7	=	42.17	(81)
Northwest	0.9x	0.77	x	2.58	x	72.63	x	0.63	x	0.7	=	57.26	(81)
Northwest	0.9x	0.77	x	4.89	x	50.42	x	0.63	x	0.7	=	75.35	(81)
Northwest	0.9x	0.77	x	1.9	x	50.42	x	0.63	x	0.7	=	29.28	(81)
Northwest	0.9x	0.77	x	2.58	x	50.42	x	0.63	x	0.7	=	39.76	(81)

Northwest 0.9x	0.77	x	4.89	x	28.07	x	0.63	x	0.7	=	41.94	(81)
Northwest 0.9x	0.77	x	1.9	x	28.07	x	0.63	x	0.7	=	16.3	(81)
Northwest 0.9x	0.77	x	2.58	x	28.07	x	0.63	x	0.7	=	22.13	(81)
Northwest 0.9x	0.77	x	4.89	x	14.2	x	0.63	x	0.7	=	21.22	(81)
Northwest 0.9x	0.77	x	1.9	x	14.2	x	0.63	x	0.7	=	8.24	(81)
Northwest 0.9x	0.77	x	2.58	x	14.2	x	0.63	x	0.7	=	11.19	(81)
Northwest 0.9x	0.77	x	4.89	x	9.21	x	0.63	x	0.7	=	13.77	(81)
Northwest 0.9x	0.77	x	1.9	x	9.21	x	0.63	x	0.7	=	5.35	(81)
Northwest 0.9x	0.77	x	2.58	x	9.21	x	0.63	x	0.7	=	7.27	(81)
Rooflights 0.9x	1	x	0.95	x	26	x	0.63	x	0.7	=	9.83	(82)
Rooflights 0.9x	1	x	0.95	x	54	x	0.63	x	0.7	=	20.41	(82)
Rooflights 0.9x	1	x	0.95	x	96	x	0.63	x	0.7	=	36.29	(82)
Rooflights 0.9x	1	x	0.95	x	150	x	0.63	x	0.7	=	56.7	(82)
Rooflights 0.9x	1	x	0.95	x	192	x	0.63	x	0.7	=	72.57	(82)
Rooflights 0.9x	1	x	0.95	x	200	x	0.63	x	0.7	=	75.6	(82)
Rooflights 0.9x	1	x	0.95	x	189	x	0.63	x	0.7	=	71.44	(82)
Rooflights 0.9x	1	x	0.95	x	157	x	0.63	x	0.7	=	59.34	(82)
Rooflights 0.9x	1	x	0.95	x	115	x	0.63	x	0.7	=	43.47	(82)
Rooflights 0.9x	1	x	0.95	x	66	x	0.63	x	0.7	=	24.95	(82)
Rooflights 0.9x	1	x	0.95	x	33	x	0.63	x	0.7	=	12.47	(82)
Rooflights 0.9x	1	x	0.95	x	21	x	0.63	x	0.7	=	7.94	(82)

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

(83)m=	50.72	103.66	186.27	303.01	403.66	428.58	401.64	322.59	226.22	126.68	63.93	41.34	(83)

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

(84)m=	327.06	378.87	452	553.18	637.52	647.09	610.42	534.64	446.47	362.61	317.93	309.36	(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	0.96	0.87	0.71	0.55	0.64	0.89	0.99	1	1	(86)

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

(87)m=	19.44	19.59	19.9	20.33	20.72	20.92	20.98	20.96	20.77	20.28	19.78	19.41	(87)

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

(88)m=	19.79	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.8	19.8	(88)

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

(89)m=	1	1	0.99	0.95	0.82	0.6	0.41	0.49	0.82	0.98	1	1	(89)

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

(90)m=	18.38	18.53	18.84	19.27	19.62	19.78	19.81	19.8	19.68	19.22	18.73	18.36	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

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(92)m=	18.87	19.03	19.34	19.77	20.13	20.31	20.36	20.35	20.19	19.72	19.22	18.85	(92)

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

(93)m=	18.87	19.03	19.34	19.77	20.13	20.31	20.36	20.35	20.19	19.72	19.22	18.85	(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	0.99	0.95	0.84	0.65	0.48	0.56	0.85	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	326.21	376.88	445.28	523.42	533.81	420.49	291.26	299.8	378.46	354.14	316.39	308.74	(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=	1178.22	1140.29	1034.11	868.58	672.7	452.68	297.56	312.21	483.63	727.39	970.34	1176.3	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	633.89	513.01	438.09	248.51	103.34	0	0	0	0	277.7	470.84	645.47	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3330.85 (98)

Space heating requirement in kWh/m²/year 56.22 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	744.78	586.32	601.37	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	634.95	533.42	521.62	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	816.85	773.25	687.86	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	130.97	178.44	123.68	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 433.08 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	32.74	44.61	30.92	0	0	0	0

Total = Sum(107)$_{6...8}$ = 108.27 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 1.83 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 58.04 (109)

Target Fabric Energy Efficiency (TFEE) 66.75 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	72.85	(1a) x	2.7	(2a) =	196.69	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.85	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	196.69	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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	=	2			(26)
Windows Type 1			4.25	x1/[1/(1.4)+ 0.04]		=	5.63			(27)
Windows Type 2			5.9	x1/[1/(1.4)+ 0.04]		=	7.82			(27)
Windows Type 3			4.47	x1/[1/(1.4)+ 0.04]		=	5.93			(27)
Windows Type 4			0.91	x1/[1/(1.4)+ 0.04]		=	1.21			(27)
Rooflights			0.6817503	x1/[1/(1.7) + 0.04]		=	1.158975			(27b)
Walls Type1	40.58	15.53	25.05	x	0.18	=	4.51			(29)
Walls Type2	56.98	2	54.98	x	0.18	=	9.9			(29)
Roof	72.85	0.68	72.17	x	0.13	=	9.38			(30)
Total area of elements, m²			170.41							(31)
Party wall			23.2	x	0	=	0			(32)
Party floor			72.85							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 47.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19233.21 (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 12.16 (36)

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

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Total fabric heat loss (33) + (36) = 59.63 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.59	37.39	37.19	36.28	36.1	35.31	35.31	35.16	35.61	36.1	36.45	36.82	(38)

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

(39)m=	97.21	97.02	96.82	95.9	95.73	94.93	94.93	94.78	95.24	95.73	96.08	96.44	

Average = $Sum(39)_{1...12}$ /12= 95.9 (39)

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

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

Average = $Sum(40)_{1...12}$ /12= 1.32 (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 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 89.14 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	98.05	94.49	90.92	87.36	83.79	80.23	80.23	83.79	87.36	90.92	94.49	98.05	

Total = $Sum(44)_{1...12}$ = 1069.69 (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=	145.41	127.18	131.24	114.42	109.78	94.74	87.79	100.74	101.94	118.8	129.68	140.82	

Total = $Sum(45)_{1...12}$ = 1402.53 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	123.6	108.1	111.55	97.25	93.32	80.53	74.62	85.63	86.65	100.98	110.23	119.7	(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=	123.6	108.1	111.55	97.25	93.32	80.53	74.62	85.63	86.65	100.98	110.23	119.7	

Output from water heater (annual)1…12 | 1192.15 | (64)

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

(65)m=	30.9	27.03	27.89	24.31	23.33	20.13	18.65	21.41	21.66	25.25	27.56	29.93	(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=	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	(66)

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

(67)m=	18.17	16.14	13.13	9.94	7.43	6.27	6.78	8.81	11.82	15.01	17.52	18.68	(67)

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

(68)m=	203.86	205.97	200.64	189.29	174.97	161.5	152.51	150.39	155.72	167.07	181.4	194.86	(68)

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

(69)m=	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	(71)

Water heating gains (Table 5)

(72)m=	41.53	40.22	37.48	33.77	31.36	27.96	25.07	28.77	30.09	33.93	38.27	40.22	(72)

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

(73)m=	321.26	320.03	308.95	290.7	271.45	253.43	242.06	245.67	255.33	273.71	294.89	311.46	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	0.91	x	11.28	x	0.63	x	0.7	=	3.14	(75)
Northeast 0.9x	0.77	x	0.91	x	22.97	x	0.63	x	0.7	=	6.39	(75)
Northeast 0.9x	0.77	x	0.91	x	41.38	x	0.63	x	0.7	=	11.51	(75)
Northeast 0.9x	0.77	x	0.91	x	67.96	x	0.63	x	0.7	=	18.9	(75)
Northeast 0.9x	0.77	x	0.91	x	91.35	x	0.63	x	0.7	=	25.4	(75)
Northeast 0.9x	0.77	x	0.91	x	97.38	x	0.63	x	0.7	=	27.08	(75)
Northeast 0.9x	0.77	x	0.91	x	91.1	x	0.63	x	0.7	=	25.34	(75)
Northeast 0.9x	0.77	x	0.91	x	72.63	x	0.63	x	0.7	=	20.2	(75)
Northeast 0.9x	0.77	x	0.91	x	50.42	x	0.63	x	0.7	=	14.02	(75)
Northeast 0.9x	0.77	x	0.91	x	28.07	x	0.63	x	0.7	=	7.81	(75)
Northeast 0.9x	0.77	x	0.91	x	14.2	x	0.63	x	0.7	=	3.95	(75)
Northeast 0.9x	0.77	x	0.91	x	9.21	x	0.63	x	0.7	=	2.56	(75)
Southeast 0.9x	0.77	x	4.25	x	36.79	x	0.63	x	0.7	=	47.79	(77)
Southeast 0.9x	0.77	x	5.9	x	36.79	x	0.63	x	0.7	=	66.34	(77)
Southeast 0.9x	0.77	x	4.47	x	36.79	x	0.63	x	0.7	=	50.26	(77)
Southeast 0.9x	0.77	x	4.25	x	62.67	x	0.63	x	0.7	=	81.4	(77)
Southeast 0.9x	0.77	x	5.9	x	62.67	x	0.63	x	0.7	=	113.01	(77)
Southeast 0.9x	0.77	x	4.47	x	62.67	x	0.63	x	0.7	=	85.62	(77)
Southeast 0.9x	0.77	x	4.25	x	85.75	x	0.63	x	0.7	=	111.38	(77)
Southeast 0.9x	0.77	x	5.9	x	85.75	x	0.63	x	0.7	=	154.62	(77)
Southeast 0.9x	0.77	x	4.47	x	85.75	x	0.63	x	0.7	=	117.15	(77)
Southeast 0.9x	0.77	x	4.25	x	106.25	x	0.63	x	0.7	=	138.01	(77)
Southeast 0.9x	0.77	x	5.9	x	106.25	x	0.63	x	0.7	=	191.58	(77)
Southeast 0.9x	0.77	x	4.47	x	106.25	x	0.63	x	0.7	=	145.15	(77)
Southeast 0.9x	0.77	x	4.25	x	119.01	x	0.63	x	0.7	=	154.58	(77)
Southeast 0.9x	0.77	x	5.9	x	119.01	x	0.63	x	0.7	=	214.59	(77)
Southeast 0.9x	0.77	x	4.47	x	119.01	x	0.63	x	0.7	=	162.58	(77)
Southeast 0.9x	0.77	x	4.25	x	118.15	x	0.63	x	0.7	=	153.46	(77)
Southeast 0.9x	0.77	x	5.9	x	118.15	x	0.63	x	0.7	=	213.04	(77)
Southeast 0.9x	0.77	x	4.47	x	118.15	x	0.63	x	0.7	=	161.4	(77)
Southeast 0.9x	0.77	x	4.25	x	113.91	x	0.63	x	0.7	=	147.95	(77)
Southeast 0.9x	0.77	x	5.9	x	113.91	x	0.63	x	0.7	=	205.39	(77)
Southeast 0.9x	0.77	x	4.47	x	113.91	x	0.63	x	0.7	=	155.61	(77)
Southeast 0.9x	0.77	x	4.25	x	104.39	x	0.63	x	0.7	=	135.59	(77)
Southeast 0.9x	0.77	x	5.9	x	104.39	x	0.63	x	0.7	=	188.23	(77)
Southeast 0.9x	0.77	x	4.47	x	104.39	x	0.63	x	0.7	=	142.61	(77)
Southeast 0.9x	0.77	x	4.25	x	92.85	x	0.63	x	0.7	=	120.6	(77)
Southeast 0.9x	0.77	x	5.9	x	92.85	x	0.63	x	0.7	=	167.42	(77)
Southeast 0.9x	0.77	x	4.47	x	92.85	x	0.63	x	0.7	=	126.84	(77)

Southeast	0.9x	0.77	x	4.25	x	69.27	x	0.63	x	0.7	=	89.97	(77)
Southeast	0.9x	0.77	x	5.9	x	69.27	x	0.63	x	0.7	=	124.9	(77)
Southeast	0.9x	0.77	x	4.47	x	69.27	x	0.63	x	0.7	=	94.63	(77)
Southeast	0.9x	0.77	x	4.25	x	44.07	x	0.63	x	0.7	=	57.24	(77)
Southeast	0.9x	0.77	x	5.9	x	44.07	x	0.63	x	0.7	=	79.46	(77)
Southeast	0.9x	0.77	x	4.47	x	44.07	x	0.63	x	0.7	=	60.2	(77)
Southeast	0.9x	0.77	x	4.25	x	31.49	x	0.63	x	0.7	=	40.9	(77)
Southeast	0.9x	0.77	x	5.9	x	31.49	x	0.63	x	0.7	=	56.78	(77)
Southeast	0.9x	0.77	x	4.47	x	31.49	x	0.63	x	0.7	=	43.02	(77)
Rooflights	0.9x	1	x	0.68	x	26	x	0.63	x	0.7	=	7.04	(82)
Rooflights	0.9x	1	x	0.68	x	54	x	0.63	x	0.7	=	14.61	(82)
Rooflights	0.9x	1	x	0.68	x	96	x	0.63	x	0.7	=	25.98	(82)
Rooflights	0.9x	1	x	0.68	x	150	x	0.63	x	0.7	=	40.59	(82)
Rooflights	0.9x	1	x	0.68	x	192	x	0.63	x	0.7	=	51.95	(82)
Rooflights	0.9x	1	x	0.68	x	200	x	0.63	x	0.7	=	54.12	(82)
Rooflights	0.9x	1	x	0.68	x	189	x	0.63	x	0.7	=	51.14	(82)
Rooflights	0.9x	1	x	0.68	x	157	x	0.63	x	0.7	=	42.48	(82)
Rooflights	0.9x	1	x	0.68	x	115	x	0.63	x	0.7	=	31.12	(82)
Rooflights	0.9x	1	x	0.68	x	66	x	0.63	x	0.7	=	17.86	(82)
Rooflights	0.9x	1	x	0.68	x	33	x	0.63	x	0.7	=	8.93	(82)
Rooflights	0.9x	1	x	0.68	x	21	x	0.63	x	0.7	=	5.68	(82)

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

(83)m=	174.57	301.03	420.63	534.23	609.1	609.1	585.43	529.1	460.01	335.16	209.79	148.93	(83)

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

(84)m=	495.83	621.05	729.58	824.92	880.55	862.54	827.49	774.77	715.34	608.87	504.68	460.39	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.93	0.82	0.66	0.49	0.54	0.78	0.96	0.99	1	(86)

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

(87)m=	19.59	19.82	20.13	20.5	20.79	20.95	20.99	20.98	20.88	20.48	19.96	19.55	(87)

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

(88)m=	19.81	19.82	19.82	19.83	19.83	19.84	19.84	19.84	19.84	19.83	19.83	19.82	(88)

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

(89)m=	1	0.99	0.96	0.9	0.77	0.56	0.37	0.42	0.7	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=	18.55	18.78	19.09	19.45	19.7	19.82	19.84	19.84	19.77	19.44	18.92	18.51	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

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

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(92)m=	19.02	19.24	19.56	19.92	20.19	20.32	20.35	20.35	20.27	19.9	19.38	18.98	(92)

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

(93)m=	19.02	19.24	19.56	19.92	20.19	20.32	20.35	20.35	20.27	19.9	19.38	18.98	(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	0.96	0.9	0.78	0.6	0.43	0.47	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	492.98	611.65	701.98	745.58	690.88	516.65	351.72	367.1	522.81	569.58	498.36	458.45	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1430.53	1391.39	1264.05	1056.89	812.61	543.18	356.13	374.24	587.45	890.64	1180.24	1425.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	697.54	523.99	418.18	224.14	90.57	0	0	0	0	238.87	490.96	719.17	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3403.41 (98)

Space heating requirement in kWh/m²/year 46.72 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	892.35	702.49	720.35	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.92	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	794.08	659.76	663.78	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1084.95	1042.73	983.98	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	209.42	284.93	238.23	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 732.58 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	52.36	71.23	59.56	0	0	0	0

Total = Sum(107)$_{6...8}$ = 183.14 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.51 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 49.23 (109)

Target Fabric Energy Efficiency (TFEE) 56.62 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	61.4	(1a)	x	2.7	(2a)	=	165.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.4	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	165.78	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.32	(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
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

TFEE WorkSheet: New dwelling design stage

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

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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	=	2			(26)
Windows Type 1			1.69	x1/[1/(1.4)+ 0.04]		=	2.24			(27)
Windows Type 2			0.42	x1/[1/(1.4)+ 0.04]		=	0.56			(27)
Windows Type 3			2.87	x1/[1/(1.4)+ 0.04]		=	3.8			(27)
Windows Type 4			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Windows Type 5			2.87	x1/[1/(1.4)+ 0.04]		=	3.8			(27)
Walls Type1	51.43	13.36	38.07	x	0.18	=	6.85			(29)
Walls Type2	35.95	2	33.95	x	0.18	=	6.11			(29)
Roof	61.4	0	61.4	x	0.13	=	7.98			(30)
Total area of elements, m²			148.78							(31)
Party wall			17.92	x	0	=	0			(32)
Party floor			61.4							(32a)

** 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) = 40.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17050.8 (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 12.52 (36)

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

TFEE WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	53.18	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.77	31.6	31.43	30.64	30.49	29.8	29.8	29.68	30.07	30.49	30.79	31.1	(38)

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

(39)m=	84.95	84.77	84.61	83.82	83.67	82.98	82.98	82.85	83.25	83.67	83.97	84.28	

Average = $Sum(39)_{1...12}$ /12= 83.82 (39)

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

(40)m=	1.38	1.38	1.38	1.37	1.36	1.35	1.35	1.35	1.36	1.36	1.37	1.37	

Average = $Sum(40)_{1...12}$ /12= 1.37 (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 2.02 (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 82.2 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.42	87.13	83.84	80.55	77.27	73.98	73.98	77.27	80.55	83.84	87.13	90.42	

Total = $Sum(44)_{1...12}$ = 986.36 (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=	134.09	117.27	121.01	105.5	101.23	87.36	80.95	92.89	94	109.55	119.58	129.85	

Total = $Sum(45)_{1...12}$ = 1293.28 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	113.97	99.68	102.86	89.68	86.05	74.25	68.81	78.96	79.9	93.11	101.64	110.38	(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=	113.97	99.68	102.86	89.68	86.05	74.25	68.81	78.96	79.9	93.11	101.64	110.38

Output from water heater (annual)$_{1...12}$ 1099.29 (64)

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

(65)m=	28.49	24.92	25.72	22.42	21.51	18.56	17.2	19.74	19.97	23.28	25.41	27.59	(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=	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	(66)

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

(67)m=	15.74	13.98	11.37	8.61	6.44	5.43	5.87	7.63	10.24	13.01	15.18	16.18	(67)

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

(68)m=	176.46	178.29	173.68	163.86	151.46	139.8	132.02	130.18	134.8	144.62	157.02	168.68	(68)

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

(69)m=	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	(71)

Water heating gains (Table 5)

(72)m=	38.3	37.08	34.56	31.14	28.91	25.78	23.12	26.53	27.74	31.29	35.29	37.09	(72)

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

(73)m=	283.82	282.68	272.93	256.92	240.12	224.33	214.32	217.66	226.1	242.23	260.81	275.26	(73)

6. Solar gains:

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

TFEE WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest	0.9x	0.77	x	3.82	x	36.79		0.63	x	0.7	=	42.95	(79)
Southwest	0.9x	0.77	x	2.87	x	36.79		0.63	x	0.7	=	32.27	(79)
Southwest	0.9x	0.77	x	3.82	x	62.67		0.63	x	0.7	=	73.17	(79)
Southwest	0.9x	0.77	x	2.87	x	62.67		0.63	x	0.7	=	54.97	(79)
Southwest	0.9x	0.77	x	3.82	x	85.75		0.63	x	0.7	=	100.11	(79)
Southwest	0.9x	0.77	x	2.87	x	85.75		0.63	x	0.7	=	75.21	(79)
Southwest	0.9x	0.77	x	3.82	x	106.25		0.63	x	0.7	=	124.04	(79)
Southwest	0.9x	0.77	x	2.87	x	106.25		0.63	x	0.7	=	93.19	(79)
Southwest	0.9x	0.77	x	3.82	x	119.01		0.63	x	0.7	=	138.94	(79)
Southwest	0.9x	0.77	x	2.87	x	119.01		0.63	x	0.7	=	104.39	(79)
Southwest	0.9x	0.77	x	3.82	x	118.15		0.63	x	0.7	=	137.93	(79)
Southwest	0.9x	0.77	x	2.87	x	118.15		0.63	x	0.7	=	103.63	(79)
Southwest	0.9x	0.77	x	3.82	x	113.91		0.63	x	0.7	=	132.98	(79)
Southwest	0.9x	0.77	x	2.87	x	113.91		0.63	x	0.7	=	99.91	(79)
Southwest	0.9x	0.77	x	3.82	x	104.39		0.63	x	0.7	=	121.87	(79)
Southwest	0.9x	0.77	x	2.87	x	104.39		0.63	x	0.7	=	91.56	(79)
Southwest	0.9x	0.77	x	3.82	x	92.85		0.63	x	0.7	=	108.4	(79)
Southwest	0.9x	0.77	x	2.87	x	92.85		0.63	x	0.7	=	81.44	(79)
Southwest	0.9x	0.77	x	3.82	x	69.27		0.63	x	0.7	=	80.87	(79)
Southwest	0.9x	0.77	x	2.87	x	69.27		0.63	x	0.7	=	60.76	(79)
Southwest	0.9x	0.77	x	3.82	x	44.07		0.63	x	0.7	=	51.45	(79)
Southwest	0.9x	0.77	x	2.87	x	44.07		0.63	x	0.7	=	38.65	(79)
Southwest	0.9x	0.77	x	3.82	x	31.49		0.63	x	0.7	=	36.76	(79)
Southwest	0.9x	0.77	x	2.87	x	31.49		0.63	x	0.7	=	27.62	(79)
Northwest	0.9x	0.77	x	1.69	x	11.28	x	0.63	x	0.7	=	11.65	(81)
Northwest	0.9x	0.77	x	0.42	x	11.28	x	0.63	x	0.7	=	1.45	(81)
Northwest	0.9x	0.77	x	2.87	x	11.28	x	0.63	x	0.7	=	9.9	(81)
Northwest	0.9x	0.77	x	1.69	x	22.97	x	0.63	x	0.7	=	23.72	(81)
Northwest	0.9x	0.77	x	0.42	x	22.97	x	0.63	x	0.7	=	2.95	(81)
Northwest	0.9x	0.77	x	2.87	x	22.97	x	0.63	x	0.7	=	20.14	(81)
Northwest	0.9x	0.77	x	1.69	x	41.38	x	0.63	x	0.7	=	42.74	(81)
Northwest	0.9x	0.77	x	0.42	x	41.38	x	0.63	x	0.7	=	5.31	(81)
Northwest	0.9x	0.77	x	2.87	x	41.38	x	0.63	x	0.7	=	36.29	(81)
Northwest	0.9x	0.77	x	1.69	x	67.96	x	0.63	x	0.7	=	70.2	(81)
Northwest	0.9x	0.77	x	0.42	x	67.96	x	0.63	x	0.7	=	8.72	(81)
Northwest	0.9x	0.77	x	2.87	x	67.96	x	0.63	x	0.7	=	59.6	(81)
Northwest	0.9x	0.77	x	1.69	x	91.35	x	0.63	x	0.7	=	94.36	(81)
Northwest	0.9x	0.77	x	0.42	x	91.35	x	0.63	x	0.7	=	11.72	(81)
Northwest	0.9x	0.77	x	2.87	x	91.35	x	0.63	x	0.7	=	80.12	(81)

Northwest 0.9x	0.77	x	1.69	x	97.38	x	0.63	x	0.7	=	100.6	(81)
Northwest 0.9x	0.77	x	0.42	x	97.38	x	0.63	x	0.7	=	12.5	(81)
Northwest 0.9x	0.77	x	2.87	x	97.38	x	0.63	x	0.7	=	85.42	(81)
Northwest 0.9x	0.77	x	1.69	x	91.1	x	0.63	x	0.7	=	94.1	(81)
Northwest 0.9x	0.77	x	0.42	x	91.1	x	0.63	x	0.7	=	11.69	(81)
Northwest 0.9x	0.77	x	2.87	x	91.1	x	0.63	x	0.7	=	79.91	(81)
Northwest 0.9x	0.77	x	1.69	x	72.63	x	0.63	x	0.7	=	75.02	(81)
Northwest 0.9x	0.77	x	0.42	x	72.63	x	0.63	x	0.7	=	9.32	(81)
Northwest 0.9x	0.77	x	2.87	x	72.63	x	0.63	x	0.7	=	63.7	(81)
Northwest 0.9x	0.77	x	1.69	x	50.42	x	0.63	x	0.7	=	52.08	(81)
Northwest 0.9x	0.77	x	0.42	x	50.42	x	0.63	x	0.7	=	6.47	(81)
Northwest 0.9x	0.77	x	2.87	x	50.42	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	1.69	x	28.07	x	0.63	x	0.7	=	28.99	(81)
Northwest 0.9x	0.77	x	0.42	x	28.07	x	0.63	x	0.7	=	3.6	(81)
Northwest 0.9x	0.77	x	2.87	x	28.07	x	0.63	x	0.7	=	24.62	(81)
Northwest 0.9x	0.77	x	1.69	x	14.2	x	0.63	x	0.7	=	14.66	(81)
Northwest 0.9x	0.77	x	0.42	x	14.2	x	0.63	x	0.7	=	1.82	(81)
Northwest 0.9x	0.77	x	2.87	x	14.2	x	0.63	x	0.7	=	12.45	(81)
Northwest 0.9x	0.77	x	1.69	x	9.21	x	0.63	x	0.7	=	9.52	(81)
Northwest 0.9x	0.77	x	0.42	x	9.21	x	0.63	x	0.7	=	1.18	(81)
Northwest 0.9x	0.77	x	2.87	x	9.21	x	0.63	x	0.7	=	8.08	(81)

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

(83)m=	98.23	174.96	259.67	355.76	429.53	440.08	418.6	361.48	292.62	198.83	119.04	83.16	(83)

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

(84)m=	382.04	457.63	532.6	612.68	669.65	664.41	632.92	579.14	518.72	441.06	379.85	358.42	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.71	0.55	0.62	0.85	0.97	1	1	(86)

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

(87)m=	19.48	19.66	19.97	20.37	20.71	20.92	20.98	20.97	20.81	20.35	19.84	19.44	(87)

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

(88)m=	19.78	19.78	19.78	19.79	19.79	19.8	19.8	19.8	19.8	19.79	19.79	19.78	(88)

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

(89)m=	1	0.99	0.98	0.94	0.82	0.61	0.41	0.48	0.78	0.96	0.99	1	(89)

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

(90)m=	18.41	18.59	18.9	19.29	19.6	19.76	19.8	19.79	19.69	19.28	18.78	18.38	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

TFEE WorkSheet: New dwelling design stage

(92)m=	18.94	19.13	19.43	19.83	20.16	20.34	20.38	20.38	20.25	19.82	19.3	18.91	(92)

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

(93)m=	18.94	19.13	19.43	19.83	20.16	20.34	20.38	20.38	20.25	19.82	19.3	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=	1	0.99	0.98	0.94	0.84	0.66	0.48	0.55	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	380.48	453.43	520.5	573.48	560.07	439.2	306.78	317.28	420.02	424.04	376.76	357.3	(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=	1243.55	1206.03	1093.96	915.8	707.43	476.15	314.06	329.53	511.71	771.03	1024.82	1239.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	642.13	505.75	426.65	246.47	109.63	0	0	0	0	258.16	466.6	656.52	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3311.92 (98)

Space heating requirement in kWh/m²/year 53.94 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	780.03	614.07	629.7	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.91	0.88	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	662.84	558.69	554.29	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	851.96	813.67	751.98	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	136.17	189.7	147.08	0	0	0	0

Total = Sum(104)$_{6...8}$ = 472.96 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	34.04	47.43	36.77	0	0	0	0

Total = Sum(107)$_{6...8}$ = 118.24 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.93 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 55.87 (109)

Target Fabric Energy Efficiency (TFEE) 64.25 (109)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.4	(1a) x	2.7	(2a) =	203.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.58	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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	=	2			(26)
Windows Type 1			0.93	x1/[1/(1.4)+ 0.04]		=	1.23			(27)
Windows Type 2			1.98	x1/[1/(1.4)+ 0.04]		=	2.62			(27)
Windows Type 3			1.63	x1/[1/(1.4)+ 0.04]		=	2.16			(27)
Windows Type 4			2.04	x1/[1/(1.4)+ 0.04]		=	2.7			(27)
Windows Type 5			5.69	x1/[1/(1.4)+ 0.04]		=	7.54			(27)
Windows Type 6			0.87	x1/[1/(1.4)+ 0.04]		=	1.15			(27)
Windows Type 7			1.47	x1/[1/(1.4)+ 0.04]		=	1.95			(27)
Rooflights			0.7705792	x1/[1/(1.7) + 0.04]		=	1.309985			(27b)
Walls Type1	68.45	16.08	52.37	x	0.18	=	9.43			(29)
Walls Type2	4.03	2	2.03	x	0.18	=	0.37			(29)
Roof	75.4	0.77	74.63	x	0.13	=	9.7			(30)
Total area of elements, m²			147.88							(31)
Party wall			42.95	x	0	=	0			(32)
Party floor			75.4							(32a)

** 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) = 44.04 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14882.66 (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 | 14.96 | (36)

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

Total fabric heat loss (33) + (36) = | 59 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.97	40.68	40.4	39.08	38.84	37.69	37.69	37.47	38.13	38.84	39.33	39.86	(38)

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

(39)m=	99.96	99.68	99.4	98.08	97.83	96.68	96.68	96.47	97.12	97.83	98.33	98.85	

Average = Sum(39)$_{1...12}$ /12= | 98.08 | (39)

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

(40)m=	1.33	1.32	1.32	1.3	1.3	1.28	1.28	1.28	1.29	1.3	1.3	1.31	

Average = Sum(40)$_{1...12}$ /12= | 1.3 | (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 | 2.37 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 90.48 | (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.53	95.91	92.29	88.67	85.05	81.43	81.43	85.05	88.67	92.29	95.91	99.53	

Total = Sum(44)$_{1...12}$ = | 1085.79 | (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=	147.6	129.09	133.21	116.14	111.44	96.16	89.11	102.25	103.47	120.59	131.63	142.94	

Total = Sum(45)$_{1...12}$ = | 1423.64 | (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	125.46	109.73	113.23	98.72	94.72	81.74	75.74	86.91	87.95	102.5	111.89	121.5	(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=	125.46	109.73	113.23	98.72	94.72	81.74	75.74	86.91	87.95	102.5	111.89	121.5	

Output from water heater (annual)$_{1...12}$ — 1210.1 (64)

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

(65)m=	31.37	27.43	28.31	24.68	23.68	20.43	18.94	21.73	21.99	25.63	27.97	30.38	(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=	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	(66)

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

(67)m=	18.68	16.59	13.49	10.21	7.64	6.45	6.97	9.05	12.15	15.43	18.01	19.2	(67)

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

(68)m=	209.56	211.73	206.25	194.59	179.86	166.02	156.78	154.6	160.08	171.75	186.47	200.31	(68)

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

(69)m=	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	(71)

Water heating gains (Table 5)

(72)m=	42.16	40.82	38.05	34.28	31.83	28.38	25.45	29.21	30.54	34.44	38.85	40.83	(72)

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

(73)m=	328.94	327.69	316.34	297.63	277.87	259.4	247.74	251.41	261.32	280.17	301.88	318.89	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	5.69	x	11.28	x	0.63	x	0.7	=	19.62	(75)
Northeast 0.9x	0.77	x	0.87	x	11.28	x	0.63	x	0.7	=	3	(75)
Northeast 0.9x	0.77	x	5.69	x	22.97	x	0.63	x	0.7	=	39.94	(75)
Northeast 0.9x	0.77	x	0.87	x	22.97	x	0.63	x	0.7	=	6.11	(75)
Northeast 0.9x	0.77	x	5.69	x	41.38	x	0.63	x	0.7	=	71.96	(75)
Northeast 0.9x	0.77	x	0.87	x	41.38	x	0.63	x	0.7	=	11	(75)
Northeast 0.9x	0.77	x	5.69	x	67.96	x	0.63	x	0.7	=	118.17	(75)
Northeast 0.9x	0.77	x	0.87	x	67.96	x	0.63	x	0.7	=	18.07	(75)
Northeast 0.9x	0.77	x	5.69	x	91.35	x	0.63	x	0.7	=	158.84	(75)
Northeast 0.9x	0.77	x	0.87	x	91.35	x	0.63	x	0.7	=	24.29	(75)
Northeast 0.9x	0.77	x	5.69	x	97.38	x	0.63	x	0.7	=	169.35	(75)
Northeast 0.9x	0.77	x	0.87	x	97.38	x	0.63	x	0.7	=	25.89	(75)
Northeast 0.9x	0.77	x	5.69	x	91.1	x	0.63	x	0.7	=	158.42	(75)
Northeast 0.9x	0.77	x	0.87	x	91.1	x	0.63	x	0.7	=	24.22	(75)
Northeast 0.9x	0.77	x	5.69	x	72.63	x	0.63	x	0.7	=	126.29	(75)
Northeast 0.9x	0.77	x	0.87	x	72.63	x	0.63	x	0.7	=	19.31	(75)
Northeast 0.9x	0.77	x	5.69	x	50.42	x	0.63	x	0.7	=	87.68	(75)
Northeast 0.9x	0.77	x	0.87	x	50.42	x	0.63	x	0.7	=	13.41	(75)
Northeast 0.9x	0.77	x	5.69	x	28.07	x	0.63	x	0.7	=	48.81	(75)
Northeast 0.9x	0.77	x	0.87	x	28.07	x	0.63	x	0.7	=	7.46	(75)
Northeast 0.9x	0.77	x	5.69	x	14.2	x	0.63	x	0.7	=	24.69	(75)
Northeast 0.9x	0.77	x	0.87	x	14.2	x	0.63	x	0.7	=	3.77	(75)
Northeast 0.9x	0.77	x	5.69	x	9.21	x	0.63	x	0.7	=	16.02	(75)
Northeast 0.9x	0.77	x	0.87	x	9.21	x	0.63	x	0.7	=	2.45	(75)
Southeast 0.9x	0.77	x	1.47	x	36.79	x	0.63	x	0.7	=	33.06	(77)
Southeast 0.9x	0.77	x	1.47	x	62.67	x	0.63	x	0.7	=	56.31	(77)
Southeast 0.9x	0.77	x	1.47	x	85.75	x	0.63	x	0.7	=	77.05	(77)
Southeast 0.9x	0.77	x	1.47	x	106.25	x	0.63	x	0.7	=	95.47	(77)
Southeast 0.9x	0.77	x	1.47	x	119.01	x	0.63	x	0.7	=	106.93	(77)
Southeast 0.9x	0.77	x	1.47	x	118.15	x	0.63	x	0.7	=	106.16	(77)
Southeast 0.9x	0.77	x	1.47	x	113.91	x	0.63	x	0.7	=	102.35	(77)
Southeast 0.9x	0.77	x	1.47	x	104.39	x	0.63	x	0.7	=	93.8	(77)
Southeast 0.9x	0.77	x	1.47	x	92.85	x	0.63	x	0.7	=	83.43	(77)
Southeast 0.9x	0.77	x	1.47	x	69.27	x	0.63	x	0.7	=	62.24	(77)
Southeast 0.9x	0.77	x	1.47	x	44.07	x	0.63	x	0.7	=	39.6	(77)
Southeast 0.9x	0.77	x	1.47	x	31.49	x	0.63	x	0.7	=	28.29	(77)
Southwest 0.9x	0.77	x	0.93	x	36.79		0.63	x	0.7	=	10.46	(79)
Southwest 0.9x	0.77	x	1.98	x	36.79		0.63	x	0.7	=	22.26	(79)
Southwest 0.9x	0.77	x	1.63	x	36.79		0.63	x	0.7	=	18.33	(79)

TFEE WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	2.04	x	36.79	0.63	x	0.7	=	22.94	(79)
Southwest	0.9x	0.77	x	0.93	x	62.67	0.63	x	0.7	=	17.81	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67	0.63	x	0.7	=	37.92	(79)
Southwest	0.9x	0.77	x	1.63	x	62.67	0.63	x	0.7	=	31.22	(79)
Southwest	0.9x	0.77	x	2.04	x	62.67	0.63	x	0.7	=	39.07	(79)
Southwest	0.9x	0.77	x	0.93	x	85.75	0.63	x	0.7	=	24.37	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75	0.63	x	0.7	=	51.89	(79)
Southwest	0.9x	0.77	x	1.63	x	85.75	0.63	x	0.7	=	42.72	(79)
Southwest	0.9x	0.77	x	2.04	x	85.75	0.63	x	0.7	=	53.46	(79)
Southwest	0.9x	0.77	x	0.93	x	106.25	0.63	x	0.7	=	30.2	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.63	x	0.7	=	64.29	(79)
Southwest	0.9x	0.77	x	1.63	x	106.25	0.63	x	0.7	=	52.93	(79)
Southwest	0.9x	0.77	x	2.04	x	106.25	0.63	x	0.7	=	66.24	(79)
Southwest	0.9x	0.77	x	0.93	x	119.01	0.63	x	0.7	=	33.83	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.63	x	0.7	=	72.01	(79)
Southwest	0.9x	0.77	x	1.63	x	119.01	0.63	x	0.7	=	59.29	(79)
Southwest	0.9x	0.77	x	2.04	x	119.01	0.63	x	0.7	=	74.2	(79)
Southwest	0.9x	0.77	x	0.93	x	118.15	0.63	x	0.7	=	33.58	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.63	x	0.7	=	71.49	(79)
Southwest	0.9x	0.77	x	1.63	x	118.15	0.63	x	0.7	=	58.86	(79)
Southwest	0.9x	0.77	x	2.04	x	118.15	0.63	x	0.7	=	73.66	(79)
Southwest	0.9x	0.77	x	0.93	x	113.91	0.63	x	0.7	=	32.38	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.63	x	0.7	=	68.93	(79)
Southwest	0.9x	0.77	x	1.63	x	113.91	0.63	x	0.7	=	56.74	(79)
Southwest	0.9x	0.77	x	2.04	x	113.91	0.63	x	0.7	=	71.02	(79)
Southwest	0.9x	0.77	x	0.93	x	104.39	0.63	x	0.7	=	29.67	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.63	x	0.7	=	63.17	(79)
Southwest	0.9x	0.77	x	1.63	x	104.39	0.63	x	0.7	=	52	(79)
Southwest	0.9x	0.77	x	2.04	x	104.39	0.63	x	0.7	=	65.08	(79)
Southwest	0.9x	0.77	x	0.93	x	92.85	0.63	x	0.7	=	26.39	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.63	x	0.7	=	56.19	(79)
Southwest	0.9x	0.77	x	1.63	x	92.85	0.63	x	0.7	=	46.25	(79)
Southwest	0.9x	0.77	x	2.04	x	92.85	0.63	x	0.7	=	57.89	(79)
Southwest	0.9x	0.77	x	0.93	x	69.27	0.63	x	0.7	=	19.69	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.63	x	0.7	=	41.91	(79)
Southwest	0.9x	0.77	x	1.63	x	69.27	0.63	x	0.7	=	34.51	(79)
Southwest	0.9x	0.77	x	2.04	x	69.27	0.63	x	0.7	=	43.18	(79)
Southwest	0.9x	0.77	x	0.93	x	44.07	0.63	x	0.7	=	12.53	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.63	x	0.7	=	26.67	(79)
Southwest	0.9x	0.77	x	1.63	x	44.07	0.63	x	0.7	=	21.95	(79)
Southwest	0.9x	0.77	x	2.04	x	44.07	0.63	x	0.7	=	27.48	(79)

Southwest	0.9x	0.77	x	0.93	x	31.49		0.63	x	0.7	=	8.95	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49		0.63	x	0.7	=	19.05	(79)
Southwest	0.9x	0.77	x	1.63	x	31.49		0.63	x	0.7	=	15.69	(79)
Southwest	0.9x	0.77	x	2.04	x	31.49		0.63	x	0.7	=	19.63	(79)
Rooflights	0.9x	1	x	0.77	x	26	x	0.63	x	0.7	=	7.95	(82)
Rooflights	0.9x	1	x	0.77	x	54	x	0.63	x	0.7	=	16.52	(82)
Rooflights	0.9x	1	x	0.77	x	96	x	0.63	x	0.7	=	29.36	(82)
Rooflights	0.9x	1	x	0.77	x	150	x	0.63	x	0.7	=	45.88	(82)
Rooflights	0.9x	1	x	0.77	x	192	x	0.63	x	0.7	=	58.72	(82)
Rooflights	0.9x	1	x	0.77	x	200	x	0.63	x	0.7	=	61.17	(82)
Rooflights	0.9x	1	x	0.77	x	189	x	0.63	x	0.7	=	57.8	(82)
Rooflights	0.9x	1	x	0.77	x	157	x	0.63	x	0.7	=	48.02	(82)
Rooflights	0.9x	1	x	0.77	x	115	x	0.63	x	0.7	=	35.17	(82)
Rooflights	0.9x	1	x	0.77	x	66	x	0.63	x	0.7	=	20.19	(82)
Rooflights	0.9x	1	x	0.77	x	33	x	0.63	x	0.7	=	10.09	(82)
Rooflights	0.9x	1	x	0.77	x	21	x	0.63	x	0.7	=	6.42	(82)

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

(83)m=	137.62	244.9	361.81	491.25	588.11	600.16	571.86	497.34	406.4	277.98	166.78	116.51	(83)

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

(84)m=	466.56	572.6	678.15	788.87	865.98	859.55	819.6	748.75	667.72	558.15	468.65	435.39	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.84	0.67	0.51	0.57	0.82	0.97	0.99	1	(86)

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

(87)m=	19.55	19.75	20.06	20.46	20.78	20.94	20.99	20.98	20.85	20.42	19.91	19.52	(87)

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

(88)m=	19.82	19.82	19.83	19.84	19.84	19.85	19.85	19.86	19.85	19.84	19.84	19.83	(88)

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

(89)m=	1	0.99	0.98	0.92	0.78	0.57	0.38	0.44	0.74	0.95	0.99	1	(89)

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

(90)m=	18.51	18.71	19.03	19.42	19.7	19.83	19.85	19.85	19.77	19.39	18.88	18.49	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	18.88	19.08	19.39	19.79	20.08	20.23	20.25	20.25	20.16	19.76	19.25	18.85	(92)

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

(93)m=	18.88	19.08	19.39	19.79	20.08	20.23	20.25	20.25	20.16	19.76	19.25	18.85	(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	0.97	0.92	0.8	0.6	0.43	0.49	0.77	0.95	0.99	1	(94)

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

(95)m=	464.66	566.73	659.52	725.26	690.54	517.73	349.17	364.07	511.2	532.05	464.6	434.08	(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=	1457.24	1413.48	1281.58	1068.03	820.14	543.98	353.37	371.58	588.21	895.93	1194.48	1448.47	(97)

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

(98)m=	738.48	569.02	462.81	246.8	96.43	0	0	0	0	270.72	525.52	754.7

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3664.47 (98)

Space heating requirement in kWh/m²/year 48.6 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	908.81	715.45	733.17	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	804.65	669.32	668.18	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1082.43	1034.49	954.77	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	200	271.69	213.23	0	0	0	0

Total = Sum(104)$_{6...8}$ = 684.92 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	50	67.92	53.31	0	0	0	0

Total = Sum(107)$_{6...8}$ = 171.23 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.27 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 50.87 (109)

Target Fabric Energy Efficiency (TFEE) 58.5 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.17	(1a) x	2.7	(2a) =	135.46	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.17	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		135.46	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.3	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.28	(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
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

DFEE WorkSheet: New dwelling design stage

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

0.35	0.34	0.34	0.3	0.3	0.26	0.26	0.25	0.28	0.3	0.31	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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	1.3	=	2.6			(26)
Windows Type 1			9.56	x1/[1/(1.3)+ 0.04]		=	11.81			(27)
Windows Type 2			4.62	x1/[1/(1.3)+ 0.04]		=	5.71			(27)
Windows Type 3			4.17	x1/[1/(1.3)+ 0.04]		=	5.15			(27)
Rooflights Type 1			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Rooflights Type 2			1.79	x1/[1/(1.6) + 0.04]		=	2.864			(27b)
Walls Type1	35.48	22.52	12.96	x	0.15	=	1.94			(29)
Walls Type2	30.48	2	28.48	x	0.13	=	3.8			(29)
Roof	50.17	2.84	47.33	x	0.1	=	4.73			(30)
Total area of elements, m²			116.13							(31)
Party wall			26.97	x	0	=	0			(32)
Party floor			50.17							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10845.77 (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 14.19 (36)

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

DFEE WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	59.37	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.1	25	24.89	24.4	24.31	23.88	23.88	23.8	24.04	24.31	24.5	24.69	(38)

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

(39)m=	84.48	84.37	84.27	83.77	83.68	83.25	83.25	83.17	83.42	83.68	83.87	84.06	

Average = $Sum(39)_{1...12}$ /12= 83.77 (39)

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

(40)m=	1.68	1.68	1.68	1.67	1.67	1.66	1.66	1.66	1.66	1.67	1.67	1.68	

Average = $Sum(40)_{1...12}$ /12= 1.67 (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 1.7 (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 74.46 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.9	78.93	75.95	72.97	69.99	67.01	67.01	69.99	72.97	75.95	78.93	81.9

Total = $Sum(44)_{1...12}$ = 893.51 (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=	121.46	106.23	109.62	95.57	91.7	79.13	73.33	84.14	85.15	99.23	108.32	117.63

Total = $Sum(45)_{1...12}$ = 1171.53 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	103.24	90.3	93.18	81.24	77.95	67.26	62.33	71.52	72.38	84.35	92.07	99.99	(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=	103.24	90.3	93.18	81.24	77.95	67.26	62.33	71.52	72.38	84.35	92.07	99.99

Output from water heater (annual)$_{1\ldots12}$ — 995.8 (64)

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

(65)m=	25.81	22.57	23.29	20.31	19.49	16.82	15.58	17.88	18.09	21.09	23.02	25	(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=	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	13.17	11.69	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.69	13.53	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	147.68	149.21	145.35	137.13	126.75	116.99	110.48	108.95	112.81	121.03	131.41	141.16	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	(71)
Water heating gains (Table 5)													
(72)m=	34.69	33.59	31.31	28.21	26.19	23.35	20.94	24.03	25.13	28.34	31.97	33.6	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	243.96	242.92	234.59	220.96	206.75	193.32	184.76	187.79	194.93	208.67	224.5	236.71	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	9.56	x	11.28	x	0.55	x	0.7	=	28.78	(75)
Northeast	0.9x	0.77	x	4.62	x	11.28	x	0.55	x	0.7	=	13.91	(75)
Northeast	0.9x	0.77	x	9.56	x	22.97	x	0.55	x	0.7	=	58.58	(75)
Northeast	0.9x	0.77	x	4.62	x	22.97	x	0.55	x	0.7	=	28.31	(75)
Northeast	0.9x	0.77	x	9.56	x	41.38	x	0.55	x	0.7	=	105.54	(75)
Northeast	0.9x	0.77	x	4.62	x	41.38	x	0.55	x	0.7	=	51.01	(75)
Northeast	0.9x	0.77	x	9.56	x	67.96	x	0.55	x	0.7	=	173.33	(75)
Northeast	0.9x	0.77	x	4.62	x	67.96	x	0.55	x	0.7	=	83.77	(75)
Northeast	0.9x	0.77	x	9.56	x	91.35	x	0.55	x	0.7	=	232.99	(75)
Northeast	0.9x	0.77	x	4.62	x	91.35	x	0.55	x	0.7	=	112.6	(75)
Northeast	0.9x	0.77	x	9.56	x	97.38	x	0.55	x	0.7	=	248.39	(75)
Northeast	0.9x	0.77	x	4.62	x	97.38	x	0.55	x	0.7	=	120.04	(75)
Northeast	0.9x	0.77	x	9.56	x	91.1	x	0.55	x	0.7	=	232.37	(75)
Northeast	0.9x	0.77	x	4.62	x	91.1	x	0.55	x	0.7	=	112.29	(75)
Northeast	0.9x	0.77	x	9.56	x	72.63	x	0.55	x	0.7	=	185.25	(75)
Northeast	0.9x	0.77	x	4.62	x	72.63	x	0.55	x	0.7	=	89.52	(75)
Northeast	0.9x	0.77	x	9.56	x	50.42	x	0.55	x	0.7	=	128.61	(75)
Northeast	0.9x	0.77	x	4.62	x	50.42	x	0.55	x	0.7	=	62.15	(75)
Northeast	0.9x	0.77	x	9.56	x	28.07	x	0.55	x	0.7	=	71.59	(75)
Northeast	0.9x	0.77	x	4.62	x	28.07	x	0.55	x	0.7	=	34.6	(75)
Northeast	0.9x	0.77	x	9.56	x	14.2	x	0.55	x	0.7	=	36.21	(75)
Northeast	0.9x	0.77	x	4.62	x	14.2	x	0.55	x	0.7	=	17.5	(75)
Northeast	0.9x	0.77	x	9.56	x	9.21	x	0.55	x	0.7	=	23.5	(75)
Northeast	0.9x	0.77	x	4.62	x	9.21	x	0.55	x	0.7	=	11.36	(75)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.55	x	0.7	=	25.11	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.55	x	0.7	=	51.1	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.55	x	0.7	=	92.07	(81)
Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.55	x	0.7	=	151.21	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.55	x	0.7	=	203.26	(81)
Northwest	0.9x	0.77	x	4.17	x	97.38	x	0.55	x	0.7	=	216.7	(81)
Northwest	0.9x	0.77	x	4.17	x	91.1	x	0.55	x	0.7	=	202.71	(81)
Northwest	0.9x	0.77	x	4.17	x	72.63	x	0.55	x	0.7	=	161.61	(81)
Northwest	0.9x	0.77	x	4.17	x	50.42	x	0.55	x	0.7	=	112.19	(81)
Northwest	0.9x	0.77	x	4.17	x	28.07	x	0.55	x	0.7	=	62.45	(81)
Northwest	0.9x	0.77	x	4.17	x	14.2	x	0.55	x	0.7	=	31.59	(81)
Northwest	0.9x	0.77	x	4.17	x	9.21	x	0.55	x	0.7	=	20.5	(81)
Rooflights	0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights	0.9x	1	x	1.79	x	26	x	0.55	x	0.8	=	18.43	(82)
Rooflights	0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)

Rooflights 0.9x	1	x	1.79	x	54	x	0.55	x	0.8	=	38.28	(82)
Rooflights 0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights 0.9x	1	x	1.79	x	96	x	0.55	x	0.8	=	68.05	(82)
Rooflights 0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights 0.9x	1	x	1.79	x	150	x	0.55	x	0.8	=	106.33	(82)
Rooflights 0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights 0.9x	1	x	1.79	x	192	x	0.55	x	0.8	=	136.1	(82)
Rooflights 0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights 0.9x	1	x	1.79	x	200	x	0.55	x	0.8	=	141.77	(82)
Rooflights 0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights 0.9x	1	x	1.79	x	189	x	0.55	x	0.8	=	133.97	(82)
Rooflights 0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights 0.9x	1	x	1.79	x	157	x	0.55	x	0.8	=	111.29	(82)
Rooflights 0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights 0.9x	1	x	1.79	x	115	x	0.55	x	0.8	=	81.52	(82)
Rooflights 0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights 0.9x	1	x	1.79	x	66	x	0.55	x	0.8	=	46.78	(82)
Rooflights 0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights 0.9x	1	x	1.79	x	33	x	0.55	x	0.8	=	23.39	(82)
Rooflights 0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)
Rooflights 0.9x	1	x	1.79	x	21	x	0.55	x	0.8	=	14.89	(82)

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

(83)m=	97.03	198.73	356.59	577.01	764.78	810.06	759.93	612.94	432.28	242.87	122.41	78.98	(83)

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

(84)m=	340.99	441.65	591.18	797.96	971.53	1003.38	944.69	800.73	627.21	451.54	346.91	315.7	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.87	0.7	0.51	0.38	0.46	0.76	0.96	0.99	1	(86)

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

(87)m=	19.17	19.43	19.89	20.46	20.82	20.96	20.99	20.98	20.83	20.25	19.6	19.13	(87)

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

(88)m=	19.55	19.55	19.56	19.56	19.56	19.57	19.57	19.57	19.57	19.56	19.56	19.56	(88)

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

(89)m=	0.99	0.99	0.95	0.83	0.62	0.4	0.26	0.33	0.65	0.94	0.99	1	(89)

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

(90)m=	17.93	18.19	18.64	19.17	19.47	19.56	19.57	19.57	19.49	19	18.36	17.89	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

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

(92)m=	18.52	18.77	19.23	19.78	20.11	20.22	20.24	20.23	20.12	19.59	18.95	18.47	(92)

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

(93)m=	18.52	18.77	19.23	19.78	20.11	20.22	20.24	20.23	20.12	19.59	18.95	18.47	(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	0.84	0.65	0.45	0.32	0.39	0.7	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	338.81	434.49	561.11	669.92	630.57	453.6	300.28	313.01	436.26	422.78	342.6	314.16	(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=	1201.22	1170.57	1072.68	911.45	703.6	467.82	303.06	318.93	502.17	752.6	993.43	1199.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	641.63	494.65	380.61	173.9	54.33	0	0	0	0	245.38	468.6	659.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3118.1 (98)

Space heating requirement in kWh/m²/year 62.15 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	782.57	616.07	632.11	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.92	0.95	0.92	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	720.58	586.41	582.32	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1198.95	1131.23	969.98	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	344.42	405.34	288.42	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1038.18 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	86.1	101.34	72.1	0	0	0	0

Total = Sum(107)$_{6...8}$ = 259.54 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 5.17 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 67.32 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.25	(1a)	x	2.7	(2a)	=	159.98	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	159.98	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.28	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.21	(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
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

DFEE WorkSheet: New dwelling design stage

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

0.27	0.27	0.26	0.23	0.23	0.2	0.2	0.2	0.21	0.23	0.24	0.25

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(24d)

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

(25)m=	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(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	1.3	=	2.6			(26)
Windows Type 1			8.26	x1/[1/(1.3)+ 0.04]		=	10.21			(27)
Windows Type 2			4.21	x1/[1/(1.3)+ 0.04]		=	5.2			(27)
Windows Type 3			3.21	x1/[1/(1.3)+ 0.04]		=	3.97			(27)
Windows Type 4			4.37	x1/[1/(1.3)+ 0.04]		=	5.4			(27)
Rooflights			1.61	x1/[1/(1.6) + 0.04]		=	2.576			(27b)
Walls Type1	38.95	20.05	18.9	x	0.15	=	2.84			(29)
Walls Type2	45.47	2	43.47	x	0.13	=	5.81			(29)
Roof	59.25	1.61	57.64	x	0.1	=	5.76			(30)
Total area of elements, m²			143.67							(31)
Party wall			25.95	x	0	=	0			(32)
Party floor			59.25							(32a)

** 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) = 44.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15258.06 (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 14.56 (36)

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

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Total fabric heat loss (33) + (36) = 58.77 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.35	28.27	28.2	27.85	27.78	27.48	27.48	27.42	27.6	27.78	27.91	28.05	(38)

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

(39)m=	87.11	87.04	86.96	86.61	86.55	86.24	86.24	86.19	86.36	86.55	86.68	86.82	

Average = Sum(39)$_{1…12}$ /12= 86.61 (39)

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

(40)m=	1.47	1.47	1.47	1.46	1.46	1.46	1.46	1.45	1.46	1.46	1.46	1.47	

Average = Sum(40)$_{1…12}$ /12= 1.46 (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 1.96 (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 80.76 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	88.83	85.6	82.37	79.14	75.91	72.68	72.68	75.91	79.14	82.37	85.6	88.83	

Total = Sum(44)$_{1…12}$ = 969.1 (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=	131.74	115.22	118.9	103.66	99.46	85.83	79.53	91.26	92.35	107.63	117.49	127.58	

Total = Sum(45)$_{1…12}$ = 1270.64 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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)

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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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

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

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

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

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

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

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

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

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

(62)m=	111.98	97.94	101.06	88.11	84.54	72.95	67.6	77.57	78.5	91.48	99.86	108.44	(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=	111.98	97.94	101.06	88.11	84.54	72.95	67.6	77.57	78.5	91.48	99.86	108.44

Output from water heater (annual)$_{1...12}$ | 1080.05 | (64)

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

(65)m=	27.99	24.48	25.27	22.03	21.14	18.24	16.9	19.39	19.63	22.87	24.97	27.11	(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=	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	(66)

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

(67)m=	15.25	13.54	11.02	8.34	6.23	5.26	5.69	7.39	9.92	12.6	14.7	15.67	(67)

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

(68)m=	171.05	172.83	168.35	158.83	146.81	135.51	127.97	126.19	130.66	140.19	152.21	163.5	(68)

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

(69)m=	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	(71)

Water heating gains (Table 5)

(72)m=	37.63	36.43	33.96	30.59	28.41	25.33	22.72	26.07	27.26	30.74	34.67	36.44	(72)

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

(73)m=	276.33	275.21	265.73	250.17	233.86	218.51	208.77	212.06	220.25	235.93	253.99	268.02	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	4.21	x	11.28	x	0.55	x	0.7	=	12.67	(75)
Northeast	0.9x	0.77	x	4.21	x	22.97	x	0.55	x	0.7	=	25.8	(75)
Northeast	0.9x	0.77	x	4.21	x	41.38	x	0.55	x	0.7	=	46.48	(75)
Northeast	0.9x	0.77	x	4.21	x	67.96	x	0.55	x	0.7	=	76.33	(75)
Northeast	0.9x	0.77	x	4.21	x	91.35	x	0.55	x	0.7	=	102.6	(75)
Northeast	0.9x	0.77	x	4.21	x	97.38	x	0.55	x	0.7	=	109.39	(75)
Northeast	0.9x	0.77	x	4.21	x	91.1	x	0.55	x	0.7	=	102.33	(75)
Northeast	0.9x	0.77	x	4.21	x	72.63	x	0.55	x	0.7	=	81.58	(75)
Northeast	0.9x	0.77	x	4.21	x	50.42	x	0.55	x	0.7	=	56.63	(75)
Northeast	0.9x	0.77	x	4.21	x	28.07	x	0.55	x	0.7	=	31.53	(75)
Northeast	0.9x	0.77	x	4.21	x	14.2	x	0.55	x	0.7	=	15.95	(75)
Northeast	0.9x	0.77	x	4.21	x	9.21	x	0.55	x	0.7	=	10.35	(75)
Northwest	0.9x	0.77	x	8.26	x	11.28	x	0.55	x	0.7	=	24.87	(81)
Northwest	0.9x	0.77	x	3.21	x	11.28	x	0.55	x	0.7	=	9.66	(81)
Northwest	0.9x	0.77	x	4.37	x	11.28	x	0.55	x	0.7	=	13.16	(81)
Northwest	0.9x	0.77	x	8.26	x	22.97	x	0.55	x	0.7	=	50.61	(81)
Northwest	0.9x	0.77	x	3.21	x	22.97	x	0.55	x	0.7	=	19.67	(81)
Northwest	0.9x	0.77	x	4.37	x	22.97	x	0.55	x	0.7	=	26.78	(81)
Northwest	0.9x	0.77	x	8.26	x	41.38	x	0.55	x	0.7	=	91.19	(81)
Northwest	0.9x	0.77	x	3.21	x	41.38	x	0.55	x	0.7	=	35.44	(81)
Northwest	0.9x	0.77	x	4.37	x	41.38	x	0.55	x	0.7	=	48.25	(81)
Northwest	0.9x	0.77	x	8.26	x	67.96	x	0.55	x	0.7	=	149.76	(81)
Northwest	0.9x	0.77	x	3.21	x	67.96	x	0.55	x	0.7	=	58.2	(81)
Northwest	0.9x	0.77	x	4.37	x	67.96	x	0.55	x	0.7	=	79.23	(81)
Northwest	0.9x	0.77	x	8.26	x	91.35	x	0.55	x	0.7	=	201.31	(81)
Northwest	0.9x	0.77	x	3.21	x	91.35	x	0.55	x	0.7	=	78.23	(81)
Northwest	0.9x	0.77	x	4.37	x	91.35	x	0.55	x	0.7	=	106.5	(81)
Northwest	0.9x	0.77	x	8.26	x	97.38	x	0.55	x	0.7	=	214.62	(81)
Northwest	0.9x	0.77	x	3.21	x	97.38	x	0.55	x	0.7	=	83.4	(81)
Northwest	0.9x	0.77	x	4.37	x	97.38	x	0.55	x	0.7	=	113.54	(81)
Northwest	0.9x	0.77	x	8.26	x	91.1	x	0.55	x	0.7	=	200.77	(81)
Northwest	0.9x	0.77	x	3.21	x	91.1	x	0.55	x	0.7	=	78.02	(81)
Northwest	0.9x	0.77	x	4.37	x	91.1	x	0.55	x	0.7	=	106.22	(81)
Northwest	0.9x	0.77	x	8.26	x	72.63	x	0.55	x	0.7	=	160.06	(81)
Northwest	0.9x	0.77	x	3.21	x	72.63	x	0.55	x	0.7	=	62.2	(81)
Northwest	0.9x	0.77	x	4.37	x	72.63	x	0.55	x	0.7	=	84.68	(81)
Northwest	0.9x	0.77	x	8.26	x	50.42	x	0.55	x	0.7	=	111.12	(81)
Northwest	0.9x	0.77	x	3.21	x	50.42	x	0.55	x	0.7	=	43.18	(81)
Northwest	0.9x	0.77	x	4.37	x	50.42	x	0.55	x	0.7	=	58.79	(81)

Northwest 0.9x	0.77	x	8.26	x	28.07	x	0.55	x	0.7	=	61.85	(81)
Northwest 0.9x	0.77	x	3.21	x	28.07	x	0.55	x	0.7	=	24.04	(81)
Northwest 0.9x	0.77	x	4.37	x	28.07	x	0.55	x	0.7	=	32.72	(81)
Northwest 0.9x	0.77	x	8.26	x	14.2	x	0.55	x	0.7	=	31.29	(81)
Northwest 0.9x	0.77	x	3.21	x	14.2	x	0.55	x	0.7	=	12.16	(81)
Northwest 0.9x	0.77	x	4.37	x	14.2	x	0.55	x	0.7	=	16.55	(81)
Northwest 0.9x	0.77	x	8.26	x	9.21	x	0.55	x	0.7	=	20.31	(81)
Northwest 0.9x	0.77	x	3.21	x	9.21	x	0.55	x	0.7	=	7.89	(81)
Northwest 0.9x	0.77	x	4.37	x	9.21	x	0.55	x	0.7	=	10.74	(81)
Rooflights 0.9x	1	x	1.61	x	26	x	0.55	x	0.8	=	16.58	(82)
Rooflights 0.9x	1	x	1.61	x	54	x	0.55	x	0.8	=	34.43	(82)
Rooflights 0.9x	1	x	1.61	x	96	x	0.55	x	0.8	=	61.21	(82)
Rooflights 0.9x	1	x	1.61	x	150	x	0.55	x	0.8	=	95.63	(82)
Rooflights 0.9x	1	x	1.61	x	192	x	0.55	x	0.8	=	122.41	(82)
Rooflights 0.9x	1	x	1.61	x	200	x	0.55	x	0.8	=	127.51	(82)
Rooflights 0.9x	1	x	1.61	x	189	x	0.55	x	0.8	=	120.5	(82)
Rooflights 0.9x	1	x	1.61	x	157	x	0.55	x	0.8	=	100.1	(82)
Rooflights 0.9x	1	x	1.61	x	115	x	0.55	x	0.8	=	73.32	(82)
Rooflights 0.9x	1	x	1.61	x	66	x	0.55	x	0.8	=	42.08	(82)
Rooflights 0.9x	1	x	1.61	x	33	x	0.55	x	0.8	=	21.04	(82)
Rooflights 0.9x	1	x	1.61	x	21	x	0.55	x	0.8	=	13.39	(82)

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

(83)m=	76.93	157.29	282.56	459.16	611.06	648.46	607.84	488.61	343.04	192.22	96.98	62.68	(83)

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

(84)m=	353.27	432.5	548.29	709.33	844.92	866.98	816.61	700.67	563.29	428.15	350.97	330.7	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.79	0.6	0.45	0.54	0.83	0.98	1	1	(86)

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

(87)m=	19.35	19.55	19.92	20.41	20.79	20.95	20.99	20.97	20.81	20.28	19.72	19.31	(87)

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

(88)m=	19.71	19.71	19.71	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.72	19.71	(88)

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

(89)m=	1	0.99	0.98	0.9	0.72	0.49	0.33	0.4	0.74	0.96	0.99	1	(89)

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

(90)m=	18.23	18.42	18.79	19.27	19.59	19.7	19.72	19.72	19.62	19.15	18.6	18.19	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

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(92)m=	18.75	18.95	19.32	19.8	20.15	20.28	20.31	20.3	20.17	19.68	19.12	18.71	(92)

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

(93)m=	18.75	18.95	19.32	19.8	20.15	20.28	20.31	20.3	20.17	19.68	19.12	18.71	(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	0.97	0.9	0.74	0.54	0.39	0.47	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	351.96	428.74	533.29	639.96	628.94	469.54	316.2	328.18	437.7	411.94	348.46	329.77	(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=	1258.9	1222.65	1114.66	944.44	731.34	490.27	320.11	336.5	524.56	785.64	1042.04	1259.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	674.76	533.51	432.54	219.23	76.19	0	0	0	0	278.03	499.38	692.06	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3405.7 (98)

Space heating requirement in kWh/m²/year 57.48 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	810.7	638.21	655.03	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	0.94	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	728.95	599.75	591.9	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1065.09	1005.97	875.02	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	242.02	302.23	210.64	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 754.89 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	60.51	75.56	52.66	0	0	0	0

Total = Sum(107)$_{6...8}$ = 188.72 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 3.19 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 60.67 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	72.85	(1a)	x	2.7	(2a)	=	196.69	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.85	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	196.69	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.3	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.23	(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
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

DFEE WorkSheet: New dwelling design stage

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

0.3	0.29	0.29	0.26	0.25	0.22	0.22	0.22	0.23	0.25	0.26	0.28

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(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	1.3	=	2.6			(26)
Windows Type 1			7.1	x1/[1/(1.3)+ 0.04]		=	8.77			(27)
Windows Type 2			9.86	x1/[1/(1.3)+ 0.04]		=	12.18			(27)
Windows Type 3			7.48	x1/[1/(1.3)+ 0.04]		=	9.24			(27)
Windows Type 4			1.53	x1/[1/(1.3)+ 0.04]		=	1.89			(27)
Rooflights			1.14	x1/[1/(1.6) + 0.04]		=	1.824			(27b)
Walls Type1	40.58	25.97	14.61	x	0.15	=	2.19			(29)
Walls Type2	56.98	2	54.98	x	0.13	=	7.34			(29)
Roof	72.85	1.14	71.71	x	0.1	=	7.17			(30)
Total area of elements, m²			170.41							(31)
Party wall			23.2	x	0	=	0			(32)
Party floor			72.85							(32a)

** 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) = 53.11 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17245.49 (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 16.31 (36)

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

Total fabric heat loss (33) + (36) = 69.42 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	35.35	35.24	35.13	34.61	34.52	34.06	34.06	33.98	34.24	34.52	34.71	34.92	(38)

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

(39)m=	104.78	104.66	104.55	104.03	103.94	103.49	103.49	103.4	103.66	103.94	104.13	104.34	

Average = Sum(39)$_{1\ldots12}$ /12= 104.03 (39)

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

(40)m=	1.44	1.44	1.44	1.43	1.43	1.42	1.42	1.42	1.42	1.43	1.43	1.43	

Average = Sum(40)$_{1\ldots12}$ /12= 1.43 (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 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 89.14 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	98.05	94.49	90.92	87.36	83.79	80.23	80.23	83.79	87.36	90.92	94.49	98.05

Total = Sum(44)$_{1\ldots12}$ = 1069.69 (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=	145.41	127.18	131.24	114.42	109.78	94.74	87.79	100.74	101.94	118.8	129.68	140.82

Total = Sum(45)$_{1\ldots12}$ = 1402.53 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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)

DFEE WorkSheet: New dwelling design stage

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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

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

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

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

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

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

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

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

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

(62)m=	123.6	108.1	111.55	97.25	93.32	80.53	74.62	85.63	86.65	100.98	110.23	119.7	(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=	123.6	108.1	111.55	97.25	93.32	80.53	74.62	85.63	86.65	100.98	110.23	119.7

Output from water heater (annual)1…12 | 1192.15 | (64)

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

(65)m=	30.9	27.03	27.89	24.31	23.33	20.13	18.65	21.41	21.66	25.25	27.56	29.93	(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=	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	(66)

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

(67)m=	18.17	16.14	13.13	9.94	7.43	6.27	6.78	8.81	11.82	15.01	17.52	18.68	(67)

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

(68)m=	203.86	205.97	200.64	189.29	174.97	161.5	152.51	150.39	155.72	167.07	181.4	194.86	(68)

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

(69)m=	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	(71)

Water heating gains (Table 5)

(72)m=	41.53	40.22	37.48	33.77	31.36	27.96	25.07	28.77	30.09	33.93	38.27	40.22	(72)

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

(73)m=	321.26	320.03	308.95	290.7	271.45	253.43	242.06	245.67	255.33	273.71	294.89	311.46	(73)

6. Solar gains:

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

DFEE WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.53	x	11.28	x	0.55	x	0.7	=	4.61	(75)
Northeast	0.9x	0.77	x	1.53	x	22.97	x	0.55	x	0.7	=	9.38	(75)
Northeast	0.9x	0.77	x	1.53	x	41.38	x	0.55	x	0.7	=	16.89	(75)
Northeast	0.9x	0.77	x	1.53	x	67.96	x	0.55	x	0.7	=	27.74	(75)
Northeast	0.9x	0.77	x	1.53	x	91.35	x	0.55	x	0.7	=	37.29	(75)
Northeast	0.9x	0.77	x	1.53	x	97.38	x	0.55	x	0.7	=	39.75	(75)
Northeast	0.9x	0.77	x	1.53	x	91.1	x	0.55	x	0.7	=	37.19	(75)
Northeast	0.9x	0.77	x	1.53	x	72.63	x	0.55	x	0.7	=	29.65	(75)
Northeast	0.9x	0.77	x	1.53	x	50.42	x	0.55	x	0.7	=	20.58	(75)
Northeast	0.9x	0.77	x	1.53	x	28.07	x	0.55	x	0.7	=	11.46	(75)
Northeast	0.9x	0.77	x	1.53	x	14.2	x	0.55	x	0.7	=	5.8	(75)
Northeast	0.9x	0.77	x	1.53	x	9.21	x	0.55	x	0.7	=	3.76	(75)
Southeast	0.9x	0.77	x	7.1	x	36.79	x	0.55	x	0.7	=	69.7	(77)
Southeast	0.9x	0.77	x	9.86	x	36.79	x	0.55	x	0.7	=	96.79	(77)
Southeast	0.9x	0.77	x	7.48	x	36.79	x	0.55	x	0.7	=	73.43	(77)
Southeast	0.9x	0.77	x	7.1	x	62.67	x	0.55	x	0.7	=	118.72	(77)
Southeast	0.9x	0.77	x	9.86	x	62.67	x	0.55	x	0.7	=	164.87	(77)
Southeast	0.9x	0.77	x	7.48	x	62.67	x	0.55	x	0.7	=	125.08	(77)
Southeast	0.9x	0.77	x	7.1	x	85.75	x	0.55	x	0.7	=	162.44	(77)
Southeast	0.9x	0.77	x	9.86	x	85.75	x	0.55	x	0.7	=	225.59	(77)
Southeast	0.9x	0.77	x	7.48	x	85.75	x	0.55	x	0.7	=	171.14	(77)
Southeast	0.9x	0.77	x	7.1	x	106.25	x	0.55	x	0.7	=	201.27	(77)
Southeast	0.9x	0.77	x	9.86	x	106.25	x	0.55	x	0.7	=	279.52	(77)
Southeast	0.9x	0.77	x	7.48	x	106.25	x	0.55	x	0.7	=	212.05	(77)
Southeast	0.9x	0.77	x	7.1	x	119.01	x	0.55	x	0.7	=	225.44	(77)
Southeast	0.9x	0.77	x	9.86	x	119.01	x	0.55	x	0.7	=	313.08	(77)
Southeast	0.9x	0.77	x	7.48	x	119.01	x	0.55	x	0.7	=	237.51	(77)
Southeast	0.9x	0.77	x	7.1	x	118.15	x	0.55	x	0.7	=	223.81	(77)
Southeast	0.9x	0.77	x	9.86	x	118.15	x	0.55	x	0.7	=	310.82	(77)
Southeast	0.9x	0.77	x	7.48	x	118.15	x	0.55	x	0.7	=	235.79	(77)
Southeast	0.9x	0.77	x	7.1	x	113.91	x	0.55	x	0.7	=	215.78	(77)
Southeast	0.9x	0.77	x	9.86	x	113.91	x	0.55	x	0.7	=	299.66	(77)
Southeast	0.9x	0.77	x	7.48	x	113.91	x	0.55	x	0.7	=	227.33	(77)
Southeast	0.9x	0.77	x	7.1	x	104.39	x	0.55	x	0.7	=	197.75	(77)
Southeast	0.9x	0.77	x	9.86	x	104.39	x	0.55	x	0.7	=	274.62	(77)
Southeast	0.9x	0.77	x	7.48	x	104.39	x	0.55	x	0.7	=	208.33	(77)
Southeast	0.9x	0.77	x	7.1	x	92.85	x	0.55	x	0.7	=	175.89	(77)
Southeast	0.9x	0.77	x	9.86	x	92.85	x	0.55	x	0.7	=	244.27	(77)
Southeast	0.9x	0.77	x	7.48	x	92.85	x	0.55	x	0.7	=	185.3	(77)

Southeast	0.9x	0.77	x	7.1	x	69.27	x	0.55	x	0.7	=	131.21	(77)
Southeast	0.9x	0.77	x	9.86	x	69.27	x	0.55	x	0.7	=	182.22	(77)
Southeast	0.9x	0.77	x	7.48	x	69.27	x	0.55	x	0.7	=	138.24	(77)
Southeast	0.9x	0.77	x	7.1	x	44.07	x	0.55	x	0.7	=	83.48	(77)
Southeast	0.9x	0.77	x	9.86	x	44.07	x	0.55	x	0.7	=	115.94	(77)
Southeast	0.9x	0.77	x	7.48	x	44.07	x	0.55	x	0.7	=	87.95	(77)
Southeast	0.9x	0.77	x	7.1	x	31.49	x	0.55	x	0.7	=	59.65	(77)
Southeast	0.9x	0.77	x	9.86	x	31.49	x	0.55	x	0.7	=	82.83	(77)
Southeast	0.9x	0.77	x	7.48	x	31.49	x	0.55	x	0.7	=	62.84	(77)
Rooflights	0.9x	1	x	1.14	x	26	x	0.55	x	0.8	=	11.74	(82)
Rooflights	0.9x	1	x	1.14	x	54	x	0.55	x	0.8	=	24.38	(82)
Rooflights	0.9x	1	x	1.14	x	96	x	0.55	x	0.8	=	43.34	(82)
Rooflights	0.9x	1	x	1.14	x	150	x	0.55	x	0.8	=	67.72	(82)
Rooflights	0.9x	1	x	1.14	x	192	x	0.55	x	0.8	=	86.68	(82)
Rooflights	0.9x	1	x	1.14	x	200	x	0.55	x	0.8	=	90.29	(82)
Rooflights	0.9x	1	x	1.14	x	189	x	0.55	x	0.8	=	85.32	(82)
Rooflights	0.9x	1	x	1.14	x	157	x	0.55	x	0.8	=	70.88	(82)
Rooflights	0.9x	1	x	1.14	x	115	x	0.55	x	0.8	=	51.92	(82)
Rooflights	0.9x	1	x	1.14	x	66	x	0.55	x	0.8	=	29.8	(82)
Rooflights	0.9x	1	x	1.14	x	33	x	0.55	x	0.8	=	14.9	(82)
Rooflights	0.9x	1	x	1.14	x	21	x	0.55	x	0.8	=	9.48	(82)

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

(83)m=	256.27	442.43	619.4	788.29	900	900.46	865.28	781.22	677.96	492.93	308.06	218.56	(83)

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

(84)m=	577.53	762.46	928.35	1078.99	1171.45	1153.9	1107.34	1026.9	933.29	766.64	602.96	530.03	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.72	0.55	0.41	0.45	0.69	0.92	0.99	1	(86)

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

(87)m=	19.56	19.85	20.22	20.6	20.86	20.97	20.99	20.99	20.91	20.54	19.95	19.5	(87)

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

(88)m=	19.73	19.74	19.74	19.74	19.74	19.75	19.75	19.75	19.75	19.74	19.74	19.74	(88)

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

(89)m=	0.99	0.97	0.93	0.83	0.65	0.45	0.29	0.33	0.59	0.89	0.98	0.99	(89)

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

(90)m=	18.45	18.74	19.1	19.45	19.66	19.73	19.75	19.75	19.71	19.41	18.85	18.4	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

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(92)m=	18.95	19.24	19.6	19.97	20.19	20.29	20.3	20.3	20.25	19.91	19.34	18.89	(92)

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

(93)m=	18.95	19.24	19.6	19.97	20.19	20.29	20.3	20.3	20.25	19.91	19.34	18.89	(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	0.93	0.83	0.68	0.5	0.34	0.39	0.63	0.89	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	571.66	740.32	861.81	900.45	798.17	571.49	380.55	398.83	591	682.7	589.4	526.14	(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=	1534.88	1500.75	1369.69	1151.33	882.85	588.34	383.29	403.44	637.03	968.12	1275.03	1532.67	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	716.64	511.01	377.86	180.63	63	0	0	0	0	212.35	493.66	748.86	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3304.01 (98)

Space heating requirement in kWh/m²/year 45.35 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	972.76	765.79	785.85	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.93	0.96	0.95	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	901.81	735.61	744.14	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1419.39	1364.06	1273.87	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	372.66	467.56	394.12	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 1234.34 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	93.17	116.89	98.53	0	0	0	0

Total = Sum(107)$_{6...8}$ = 308.59 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 4.24 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 49.59 (109)

DFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.4	(1a) x	2.7	(2a) =	165.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.78	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.27	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.23	(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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.29	0.29	0.28	0.25	0.25	0.22	0.22	0.21	0.23	0.25	0.26	0.27

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(24d)

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	(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	1.3	=	2.6			(26)
Windows Type 1			3.7	x1/[1/(1.3)+ 0.04]		=	4.57			(27)
Windows Type 2			0.91	x1/[1/(1.3)+ 0.04]		=	1.12			(27)
Windows Type 3			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Windows Type 4			8.37	x1/[1/(1.3)+ 0.04]		=	10.34			(27)
Windows Type 5			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Walls Type1	51.43	29.26	22.17	x	0.15	=	3.33			(29)
Walls Type2	35.95	2	33.95	x	0.13	=	4.53			(29)
Roof	61.4	0	61.4	x	0.1	=	6.14			(30)
Total area of elements, m²			148.78							(31)
Party wall			17.92	x	0	=	0			(32)
Party floor			61.4							(32a)

** 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) = 52.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14029.8 (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 15.8 (36)

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

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Total fabric heat loss (33) + (36) = 68.55 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.71	29.62	29.53	29.11	29.03	28.66	28.66	28.59	28.8	29.03	29.19	29.35	(38)

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

(39)m=	98.26	98.17	98.08	97.66	97.58	97.21	97.21	97.15	97.36	97.58	97.74	97.91	

Average = $Sum(39)_{1...12}$ /12= 97.66 (39)

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

(40)m=	1.6	1.6	1.6	1.59	1.59	1.58	1.58	1.58	1.59	1.59	1.59	1.59	

Average = $Sum(40)_{1...12}$ /12= 1.59 (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 2.02 (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 82.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	90.42	87.13	83.84	80.55	77.27	73.98	73.98	77.27	80.55	83.84	87.13	90.42	

Total = $Sum(44)_{1...12}$ = 986.36 (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=	134.09	117.27	121.01	105.5	101.23	87.36	80.95	92.89	94	109.55	119.58	129.85	

Total = $Sum(45)_{1...12}$ = 1293.28 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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)

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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 x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

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

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

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

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

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

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

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

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

(62)m=	113.97	99.68	102.86	89.68	86.05	74.25	68.81	78.96	79.9	93.11	101.64	110.38	(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=	113.97	99.68	102.86	89.68	86.05	74.25	68.81	78.96	79.9	93.11	101.64	110.38

Output from water heater (annual)$_{1...12}$ 1099.29 (64)

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

(65)m=	28.49	24.92	25.72	22.42	21.51	18.56	17.2	19.74	19.97	23.28	25.41	27.59	(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=	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	(66)

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

(67)m=	15.73	13.97	11.36	8.6	6.43	5.43	5.87	7.63	10.23	13	15.17	16.17	(67)

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

(68)m=	176.46	178.29	173.68	163.86	151.46	139.8	132.02	130.18	134.8	144.62	157.02	168.68	(68)

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

(69)m=	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	(71)

Water heating gains (Table 5)

(72)m=	38.3	37.08	34.56	31.14	28.91	25.78	23.12	26.53	27.74	31.29	35.29	37.09	(72)

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

(73)m=	283.81	282.67	272.92	256.91	240.11	224.33	214.32	217.65	226.09	242.22	260.8	275.25	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)	
Southwest 0.9x	0.77	8.37	36.79	0.55	0.7	82.17	(79)
Southwest 0.9x	0.77	6.29	36.79	0.55	0.7	61.75	(79)
Southwest 0.9x	0.77	8.37	62.67	0.55	0.7	139.96	(79)
Southwest 0.9x	0.77	6.29	62.67	0.55	0.7	105.18	(79)
Southwest 0.9x	0.77	8.37	85.75	0.55	0.7	191.5	(79)
Southwest 0.9x	0.77	6.29	85.75	0.55	0.7	143.91	(79)
Southwest 0.9x	0.77	8.37	106.25	0.55	0.7	237.28	(79)
Southwest 0.9x	0.77	6.29	106.25	0.55	0.7	178.31	(79)
Southwest 0.9x	0.77	8.37	119.01	0.55	0.7	265.77	(79)
Southwest 0.9x	0.77	6.29	119.01	0.55	0.7	199.72	(79)
Southwest 0.9x	0.77	8.37	118.15	0.55	0.7	263.85	(79)
Southwest 0.9x	0.77	6.29	118.15	0.55	0.7	198.28	(79)
Southwest 0.9x	0.77	8.37	113.91	0.55	0.7	254.38	(79)
Southwest 0.9x	0.77	6.29	113.91	0.55	0.7	191.16	(79)
Southwest 0.9x	0.77	8.37	104.39	0.55	0.7	233.12	(79)
Southwest 0.9x	0.77	6.29	104.39	0.55	0.7	175.19	(79)
Southwest 0.9x	0.77	8.37	92.85	0.55	0.7	207.35	(79)
Southwest 0.9x	0.77	6.29	92.85	0.55	0.7	155.82	(79)
Southwest 0.9x	0.77	8.37	69.27	0.55	0.7	154.69	(79)
Southwest 0.9x	0.77	6.29	69.27	0.55	0.7	116.25	(79)
Southwest 0.9x	0.77	8.37	44.07	0.55	0.7	98.42	(79)
Southwest 0.9x	0.77	6.29	44.07	0.55	0.7	73.96	(79)
Southwest 0.9x	0.77	8.37	31.49	0.55	0.7	70.32	(79)
Southwest 0.9x	0.77	6.29	31.49	0.55	0.7	52.84	(79)
Northwest 0.9x	0.77	3.7	11.28	0.55	0.7	22.28	(81)
Northwest 0.9x	0.77	0.91	11.28	0.55	0.7	2.74	(81)
Northwest 0.9x	0.77	6.29	11.28	0.55	0.7	18.94	(81)
Northwest 0.9x	0.77	3.7	22.97	0.55	0.7	45.34	(81)
Northwest 0.9x	0.77	0.91	22.97	0.55	0.7	5.58	(81)
Northwest 0.9x	0.77	6.29	22.97	0.55	0.7	38.54	(81)
Northwest 0.9x	0.77	3.7	41.38	0.55	0.7	81.7	(81)
Northwest 0.9x	0.77	0.91	41.38	0.55	0.7	10.05	(81)
Northwest 0.9x	0.77	6.29	41.38	0.55	0.7	69.44	(81)
Northwest 0.9x	0.77	3.7	67.96	0.55	0.7	134.17	(81)
Northwest 0.9x	0.77	0.91	67.96	0.55	0.7	16.5	(81)
Northwest 0.9x	0.77	6.29	67.96	0.55	0.7	114.04	(81)
Northwest 0.9x	0.77	3.7	91.35	0.55	0.7	180.35	(81)
Northwest 0.9x	0.77	0.91	91.35	0.55	0.7	22.18	(81)
Northwest 0.9x	0.77	6.29	91.35	0.55	0.7	153.3	(81)

Northwest 0.9x	0.77	x	3.7	x	97.38	x	0.55	x	0.7	=	192.27	(81)
Northwest 0.9x	0.77	x	0.91	x	97.38	x	0.55	x	0.7	=	23.64	(81)
Northwest 0.9x	0.77	x	6.29	x	97.38	x	0.55	x	0.7	=	163.43	(81)
Northwest 0.9x	0.77	x	3.7	x	91.1	x	0.55	x	0.7	=	179.87	(81)
Northwest 0.9x	0.77	x	0.91	x	91.1	x	0.55	x	0.7	=	22.12	(81)
Northwest 0.9x	0.77	x	6.29	x	91.1	x	0.55	x	0.7	=	152.89	(81)
Northwest 0.9x	0.77	x	3.7	x	72.63	x	0.55	x	0.7	=	143.39	(81)
Northwest 0.9x	0.77	x	0.91	x	72.63	x	0.55	x	0.7	=	17.63	(81)
Northwest 0.9x	0.77	x	6.29	x	72.63	x	0.55	x	0.7	=	121.88	(81)
Northwest 0.9x	0.77	x	3.7	x	50.42	x	0.55	x	0.7	=	99.55	(81)
Northwest 0.9x	0.77	x	0.91	x	50.42	x	0.55	x	0.7	=	12.24	(81)
Northwest 0.9x	0.77	x	6.29	x	50.42	x	0.55	x	0.7	=	84.62	(81)
Northwest 0.9x	0.77	x	3.7	x	28.07	x	0.55	x	0.7	=	55.41	(81)
Northwest 0.9x	0.77	x	0.91	x	28.07	x	0.55	x	0.7	=	6.81	(81)
Northwest 0.9x	0.77	x	6.29	x	28.07	x	0.55	x	0.7	=	47.1	(81)
Northwest 0.9x	0.77	x	3.7	x	14.2	x	0.55	x	0.7	=	28.03	(81)
Northwest 0.9x	0.77	x	0.91	x	14.2	x	0.55	x	0.7	=	3.45	(81)
Northwest 0.9x	0.77	x	6.29	x	14.2	x	0.55	x	0.7	=	23.83	(81)
Northwest 0.9x	0.77	x	3.7	x	9.21	x	0.55	x	0.7	=	18.19	(81)
Northwest 0.9x	0.77	x	0.91	x	9.21	x	0.55	x	0.7	=	2.24	(81)
Northwest 0.9x	0.77	x	6.29	x	9.21	x	0.55	x	0.7	=	15.46	(81)

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

(83)m=	187.86	334.6	496.59	680.3	821.32	841.47	800.41	691.22	559.58	380.26	227.68	159.05	(83)

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

(84)m=	471.67	617.27	769.52	937.21	1061.43	1065.8	1014.73	908.87	785.67	622.48	488.47	434.3	(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	0.96	0.88	0.73	0.55	0.41	0.48	0.73	0.94	0.99	1	(86)

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

(87)m=	19.34	19.62	20.03	20.49	20.81	20.95	20.99	20.98	20.86	20.39	19.76	19.28	(87)

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

(88)m=	19.61	19.61	19.62	19.62	19.62	19.63	19.63	19.63	19.62	19.62	19.62	19.62	(88)

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

(89)m=	0.99	0.98	0.94	0.84	0.66	0.45	0.29	0.34	0.63	0.91	0.98	0.99	(89)

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

(90)m=	18.15	18.43	18.82	19.25	19.51	19.61	19.62	19.62	19.56	19.17	18.57	18.09	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

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(92)m=	18.74	19.02	19.42	19.87	20.16	20.28	20.3	20.3	20.21	19.78	19.16	18.69	(92)

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

(93)m=	18.74	19.02	19.42	19.87	20.16	20.28	20.3	20.3	20.21	19.78	19.16	18.69	(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	0.94	0.85	0.69	0.5	0.35	0.41	0.67	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	467.33	602.34	722.18	792.7	728.72	530.95	355.94	371.45	529.57	567.58	479.21	431.32	(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=	1419.18	1386.4	1267.38	1071.08	825.45	551.88	359.94	378.64	594.58	895.71	1178.83	1418.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	708.18	526.89	405.63	200.43	71.97	0	0	0	0	244.13	503.73	734.29	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3395.22 (98)

Space heating requirement in kWh/m²/year 55.3 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	913.82	719.39	738.32	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.95	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	834.6	682.85	684.41	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1321.12	1259.94	1137.38	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	350.3	429.35	337.01	0	0	0	0

Total = Sum(104)$_{6...8}$ = 1116.66 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	87.57	107.34	84.25	0	0	0	0

Total = Sum(107)$_{6...8}$ = 279.16 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 4.55 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 59.84 (109)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	75.4	(1a)	x	2.7	(2a)	=	203.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.4	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	203.58	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.3	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.28	(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
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.35	0.34	0.34	0.3	0.3	0.26	0.26	0.25	0.28	0.3	0.31	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(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	1.3	=	2.6			(26)
Windows Type 1			1.27	x1/[1/(1.3)+ 0.04]		=	1.57			(27)
Windows Type 2			2.7	x1/[1/(1.3)+ 0.04]		=	3.34			(27)
Windows Type 3			2.22	x1/[1/(1.3)+ 0.04]		=	2.74			(27)
Windows Type 4			2.78	x1/[1/(1.3)+ 0.04]		=	3.44			(27)
Windows Type 5			7.75	x1/[1/(1.3)+ 0.04]		=	9.58			(27)
Windows Type 6			1.19	x1/[1/(1.3)+ 0.04]		=	1.47			(27)
Windows Type 7			2	x1/[1/(1.3)+ 0.04]		=	2.47			(27)
Rooflights			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Walls Type1	68.45	21.91	46.54	x	0.15	=	6.98			(29)
Walls Type2	4.03	2	2.03	x	0.13	=	0.27			(29)
Roof	75.4	1.05	74.35	x	0.1	=	7.44			(30)
Total area of elements, m²			147.88							(31)
Party wall			42.95	x	0	=	0			(32)
Party floor			75.4							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.94 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13772.45 (34)

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

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

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 17.49 (36)

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

Total fabric heat loss — (33) + (36) = — 63.43 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.72	37.56	37.4	36.67	36.53	35.88	35.88	35.77	36.13	36.53	36.81	37.1	(38)

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

(39)m=	101.16	101	100.84	100.1	99.96	99.32	99.32	99.2	99.57	99.96	100.24	100.53	

Average = Sum(39)$_{1...12}$ /12= — 100.1 (39)

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

(40)m=	1.34	1.34	1.34	1.33	1.33	1.32	1.32	1.32	1.32	1.33	1.33	1.33

Average = Sum(40)$_{1...12}$ /12= — 1.33 (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 — 2.37 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 90.48 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	99.53	95.91	92.29	88.67	85.05	81.43	81.43	85.05	88.67	92.29	95.91	99.53

Total = Sum(44)$_{1...12}$ = — 1085.79 (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=	147.6	129.09	133.21	116.14	111.44	96.16	89.11	102.25	103.47	120.59	131.63	142.94

Total = Sum(45)$_{1...12}$ = — 1423.64 (45)

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

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = — 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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Energy lost from water storage, kWh/year (47) 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) × (41)m

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

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

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

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

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

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

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

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

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

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

(62)m=	125.46	109.73	113.23	98.72	94.72	81.74	75.74	86.91	87.95	102.5	111.89	121.5	(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=	125.46	109.73	113.23	98.72	94.72	81.74	75.74	86.91	87.95	102.5	111.89	121.5	

Output from water heater (annual)$_{1...12}$ 1210.1 (64)

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

(65)m=	31.37	27.43	28.31	24.68	23.68	20.43	18.94	21.73	21.99	25.63	27.97	30.38	(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=	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	(66)

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

(67)m=	18.68	16.59	13.49	10.22	7.64	6.45	6.97	9.06	12.15	15.43	18.01	19.2	(67)

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

(68)m=	209.56	211.73	206.25	194.59	179.86	166.02	156.78	154.6	160.08	171.75	186.47	200.31	(68)

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

(69)m=	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	(71)

Water heating gains (Table 5)

(72)m=	42.16	40.82	38.05	34.28	31.83	28.38	25.45	29.21	30.54	34.44	38.85	40.83	(72)

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

(73)m=	328.95	327.7	316.34	297.63	277.87	259.4	247.74	251.41	261.32	280.17	301.88	318.89	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	7.75	x	11.28	x	0.55	x	0.7	=	23.33	(75)
Northeast	0.9x	0.77	x	1.19	x	11.28	x	0.55	x	0.7	=	3.58	(75)
Northeast	0.9x	0.77	x	7.75	x	22.97	x	0.55	x	0.7	=	47.49	(75)
Northeast	0.9x	0.77	x	1.19	x	22.97	x	0.55	x	0.7	=	7.29	(75)
Northeast	0.9x	0.77	x	7.75	x	41.38	x	0.55	x	0.7	=	85.56	(75)
Northeast	0.9x	0.77	x	1.19	x	41.38	x	0.55	x	0.7	=	13.14	(75)
Northeast	0.9x	0.77	x	7.75	x	67.96	x	0.55	x	0.7	=	140.51	(75)
Northeast	0.9x	0.77	x	1.19	x	67.96	x	0.55	x	0.7	=	21.58	(75)
Northeast	0.9x	0.77	x	7.75	x	91.35	x	0.55	x	0.7	=	188.88	(75)
Northeast	0.9x	0.77	x	1.19	x	91.35	x	0.55	x	0.7	=	29	(75)
Northeast	0.9x	0.77	x	7.75	x	97.38	x	0.55	x	0.7	=	201.37	(75)
Northeast	0.9x	0.77	x	1.19	x	97.38	x	0.55	x	0.7	=	30.92	(75)
Northeast	0.9x	0.77	x	7.75	x	91.1	x	0.55	x	0.7	=	188.37	(75)
Northeast	0.9x	0.77	x	1.19	x	91.1	x	0.55	x	0.7	=	28.92	(75)
Northeast	0.9x	0.77	x	7.75	x	72.63	x	0.55	x	0.7	=	150.17	(75)
Northeast	0.9x	0.77	x	1.19	x	72.63	x	0.55	x	0.7	=	23.06	(75)
Northeast	0.9x	0.77	x	7.75	x	50.42	x	0.55	x	0.7	=	104.26	(75)
Northeast	0.9x	0.77	x	1.19	x	50.42	x	0.55	x	0.7	=	16.01	(75)
Northeast	0.9x	0.77	x	7.75	x	28.07	x	0.55	x	0.7	=	58.04	(75)
Northeast	0.9x	0.77	x	1.19	x	28.07	x	0.55	x	0.7	=	8.91	(75)
Northeast	0.9x	0.77	x	7.75	x	14.2	x	0.55	x	0.7	=	29.36	(75)
Northeast	0.9x	0.77	x	1.19	x	14.2	x	0.55	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	7.75	x	9.21	x	0.55	x	0.7	=	19.05	(75)
Northeast	0.9x	0.77	x	1.19	x	9.21	x	0.55	x	0.7	=	2.93	(75)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.55	x	0.7	=	39.27	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.55	x	0.7	=	66.89	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.55	x	0.7	=	91.52	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.55	x	0.7	=	113.39	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.55	x	0.7	=	127.01	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.55	x	0.7	=	126.09	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.55	x	0.7	=	121.57	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.55	x	0.7	=	111.41	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.55	x	0.7	=	99.09	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.55	x	0.7	=	73.92	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.55	x	0.7	=	47.03	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.55	x	0.7	=	33.6	(77)
Southwest	0.9x	0.77	x	1.27	x	36.79		0.55	x	0.7	=	12.47	(79)
Southwest	0.9x	0.77	x	2.7	x	36.79		0.55	x	0.7	=	26.51	(79)
Southwest	0.9x	0.77	x	2.22	x	36.79		0.55	x	0.7	=	21.79	(79)

Southwest	0.9x	0.77	x	2.78	x	36.79	0.55	x	0.7	=	27.29	(79)
Southwest	0.9x	0.77	x	1.27	x	62.67	0.55	x	0.7	=	21.24	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67	0.55	x	0.7	=	45.15	(79)
Southwest	0.9x	0.77	x	2.22	x	62.67	0.55	x	0.7	=	37.12	(79)
Southwest	0.9x	0.77	x	2.78	x	62.67	0.55	x	0.7	=	46.49	(79)
Southwest	0.9x	0.77	x	1.27	x	85.75	0.55	x	0.7	=	29.06	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75	0.55	x	0.7	=	61.77	(79)
Southwest	0.9x	0.77	x	2.22	x	85.75	0.55	x	0.7	=	50.79	(79)
Southwest	0.9x	0.77	x	2.78	x	85.75	0.55	x	0.7	=	63.6	(79)
Southwest	0.9x	0.77	x	1.27	x	106.25	0.55	x	0.7	=	36	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25	0.55	x	0.7	=	76.54	(79)
Southwest	0.9x	0.77	x	2.22	x	106.25	0.55	x	0.7	=	62.93	(79)
Southwest	0.9x	0.77	x	2.78	x	106.25	0.55	x	0.7	=	78.81	(79)
Southwest	0.9x	0.77	x	1.27	x	119.01	0.55	x	0.7	=	40.33	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01	0.55	x	0.7	=	85.73	(79)
Southwest	0.9x	0.77	x	2.22	x	119.01	0.55	x	0.7	=	70.49	(79)
Southwest	0.9x	0.77	x	2.78	x	119.01	0.55	x	0.7	=	88.27	(79)
Southwest	0.9x	0.77	x	1.27	x	118.15	0.55	x	0.7	=	40.03	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15	0.55	x	0.7	=	85.11	(79)
Southwest	0.9x	0.77	x	2.22	x	118.15	0.55	x	0.7	=	69.98	(79)
Southwest	0.9x	0.77	x	2.78	x	118.15	0.55	x	0.7	=	87.63	(79)
Southwest	0.9x	0.77	x	1.27	x	113.91	0.55	x	0.7	=	38.6	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91	0.55	x	0.7	=	82.06	(79)
Southwest	0.9x	0.77	x	2.22	x	113.91	0.55	x	0.7	=	67.47	(79)
Southwest	0.9x	0.77	x	2.78	x	113.91	0.55	x	0.7	=	84.49	(79)
Southwest	0.9x	0.77	x	1.27	x	104.39	0.55	x	0.7	=	35.37	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39	0.55	x	0.7	=	75.2	(79)
Southwest	0.9x	0.77	x	2.22	x	104.39	0.55	x	0.7	=	61.83	(79)
Southwest	0.9x	0.77	x	2.78	x	104.39	0.55	x	0.7	=	77.43	(79)
Southwest	0.9x	0.77	x	1.27	x	92.85	0.55	x	0.7	=	31.46	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85	0.55	x	0.7	=	66.89	(79)
Southwest	0.9x	0.77	x	2.22	x	92.85	0.55	x	0.7	=	55	(79)
Southwest	0.9x	0.77	x	2.78	x	92.85	0.55	x	0.7	=	68.87	(79)
Southwest	0.9x	0.77	x	1.27	x	69.27	0.55	x	0.7	=	23.47	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27	0.55	x	0.7	=	49.9	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27	0.55	x	0.7	=	41.03	(79)
Southwest	0.9x	0.77	x	2.78	x	69.27	0.55	x	0.7	=	51.38	(79)
Southwest	0.9x	0.77	x	1.27	x	44.07	0.55	x	0.7	=	14.93	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07	0.55	x	0.7	=	31.75	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07	0.55	x	0.7	=	26.1	(79)
Southwest	0.9x	0.77	x	2.78	x	44.07	0.55	x	0.7	=	32.69	(79)

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Southwest	0.9x	0.77	x	1.27	x	31.49		0.55	x	0.7	=	10.67	(79)
Southwest	0.9x	0.77	x	2.7	x	31.49		0.55	x	0.7	=	22.68	(79)
Southwest	0.9x	0.77	x	2.22	x	31.49		0.55	x	0.7	=	18.65	(79)
Southwest	0.9x	0.77	x	2.78	x	31.49		0.55	x	0.7	=	23.36	(79)
Rooflights	0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights	0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)
Rooflights	0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights	0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights	0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights	0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights	0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights	0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights	0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights	0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights	0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights	0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)

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

(83)m=	165.05	294.11	435.36	592.14	709.55	724.3	690.06	599.75	489.39	334.09	200.09	139.67	(83)

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

(84)m=	493.99	621.81	751.7	889.77	987.42	983.7	937.8	851.16	750.71	614.26	501.97	458.56	(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=	1	0.99	0.97	0.92	0.79	0.61	0.46	0.52	0.78	0.96	0.99	1	(86)

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

(87)m=	19.56	19.78	20.12	20.52	20.82	20.96	20.99	20.98	20.88	20.46	19.92	19.52	(87)

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

(88)m=	19.81	19.81	19.81	19.82	19.82	19.83	19.83	19.83	19.82	19.82	19.82	19.81	(88)

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

(89)m=	1	0.99	0.97	0.89	0.73	0.51	0.34	0.4	0.69	0.94	0.99	1	(89)

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

(90)m=	18.51	18.74	19.07	19.46	19.71	19.81	19.83	19.82	19.76	19.4	18.88	18.47	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

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

(92)m=	18.88	19.11	19.44	19.84	20.11	20.22	20.24	20.24	20.16	19.78	19.25	18.84	(92)

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

(93)m=	18.88	19.11	19.44	19.84	20.11	20.22	20.24	20.24	20.16	19.78	19.25	18.84	(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=	0.99	0.99	0.96	0.89	0.75	0.55	0.38	0.44	0.72	0.94	0.99	1	(94)

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

(95)m=	491.46	613.24	723.11	793.03	737.06	538.42	358.4	374.94	540.07	576.62	496.37	456.85	(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=	1475.26	1435.02	1305.08	1094.67	840.22	557.95	361.42	380.55	603.26	917.45	1217.86	1472.17	(97)

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

(98)m=	731.94	552.24	432.99	217.18	76.75	0	0	0	0	253.58	519.47	755.4

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3539.55 (98)

Space heating requirement in kWh/m²/year 46.94 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	933.59	734.95	753.91	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.91	0.95	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	849.45	698.58	700.63	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	1223.82	1169.14	1071.56	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	269.54	350.1	275.97	0	0	0	0

Total = Sum(104)$_{6...8}$ = 895.62 (104)

Cooled fraction — f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	67.39	87.53	68.99	0	0	0	0

Total = Sum(107)$_{6...8}$ = 223.91 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 2.97 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency — (99) + (108) = 49.91 (109)

eight
associates

SAP Worksheets
Energy Statement
34A-36 Kilburn High Road

SAP Worksheets

TER Worksheets

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.17	(1a)	x	2.7	(2a)	=	135.46	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.17	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			135.46	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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	=	2			(26)
Windows Type 1			3.97	x1/[1/(1.4)+ 0.04]		=	5.26			(27)
Windows Type 2			1.92	x1/[1/(1.4)+ 0.04]		=	2.55			(27)
Windows Type 3			1.73	x1/[1/(1.4)+ 0.04]		=	2.29			(27)
Rooflights Type 1			0.4364994	x1/[1/(1.7) + 0.04]		=	0.7420489			(27b)
Rooflights Type 2			0.7441275	x1/[1/(1.7) + 0.04]		=	1.265017			(27b)
Walls Type1	35.48	9.35	26.13	x	0.18	=	4.7			(29)
Walls Type2	30.48	2	28.48	x	0.18	=	5.13			(29)
Roof	50.17	1.18	48.99	x	0.13	=	6.37			(30)
Total area of elements, m²			116.13							(31)
Party wall			26.97	x	0	=	0			(32)
Party floor			50.17							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13363 (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 11.14 (36)

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

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Total fabric heat loss	(33) + (36) =	43.61	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.27	27.08	26.89	26.01	25.85	25.08	25.08	24.94	25.37	25.85	26.18	26.53	(38)

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

(39)m=	70.88	70.68	70.5	69.62	69.45	68.69	68.69	68.55	68.98	69.45	69.79	70.13	

Average = $Sum(39)_{1…12}$ /12= 69.62 (39)

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

(40)m=	1.41	1.41	1.41	1.39	1.38	1.37	1.37	1.37	1.37	1.38	1.39	1.4	

Average = $Sum(40)_{1…12}$ /12= 1.39 (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 1.7 (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 74.46 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	81.9	78.93	75.95	72.97	69.99	67.01	67.01	69.99	72.97	75.95	78.93	81.9	

Total = $Sum(44)_{1…12}$ = 893.51 (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=	121.46	106.23	109.62	95.57	91.7	79.13	73.33	84.14	85.15	99.23	108.32	117.63	

Total = $Sum(45)_{1…12}$ = 1171.53 (45)

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

(46)m=	18.22	15.93	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.64	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	41.74	36.33	38.7	35.99	35.67	33.05	34.15	35.67	35.99	38.7	38.92	41.74	(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=	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37	(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=	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37

Output from water heater (annual)$_{1...12}$ 1618.16 (64)

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

(65)m=	50.82	44.4	46.12	40.77	39.41	34.57	32.92	36.89	37.31	42.67	45.75	49.55	(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=	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	(66)

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

(67)m=	13.18	11.71	9.52	7.21	5.39	4.55	4.92	6.39	8.58	10.89	12.71	13.55	(67)

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

(68)m=	147.68	149.21	145.35	137.13	126.75	116.99	110.48	108.95	112.81	121.03	131.41	141.16	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	(71)

Water heating gains (Table 5)

(72)m=	68.31	66.08	62	56.63	52.97	48.02	44.25	49.59	51.82	57.35	63.54	66.59	(72)

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

(73)m=	280.59	278.42	268.29	252.39	236.53	220.99	211.07	216.35	224.63	240.7	259.08	272.73	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.97	x	11.28	x	0.63	x	0.7	=	13.69	(75)
Northeast	0.9x	0.77	x	1.92	x	11.28	x	0.63	x	0.7	=	6.62	(75)
Northeast	0.9x	0.77	x	3.97	x	22.97	x	0.63	x	0.7	=	27.87	(75)
Northeast	0.9x	0.77	x	1.92	x	22.97	x	0.63	x	0.7	=	13.48	(75)
Northeast	0.9x	0.77	x	3.97	x	41.38	x	0.63	x	0.7	=	50.2	(75)
Northeast	0.9x	0.77	x	1.92	x	41.38	x	0.63	x	0.7	=	24.28	(75)
Northeast	0.9x	0.77	x	3.97	x	67.96	x	0.63	x	0.7	=	82.45	(75)
Northeast	0.9x	0.77	x	1.92	x	67.96	x	0.63	x	0.7	=	39.87	(75)
Northeast	0.9x	0.77	x	3.97	x	91.35	x	0.63	x	0.7	=	110.83	(75)
Northeast	0.9x	0.77	x	1.92	x	91.35	x	0.63	x	0.7	=	53.6	(75)
Northeast	0.9x	0.77	x	3.97	x	97.38	x	0.63	x	0.7	=	118.15	(75)
Northeast	0.9x	0.77	x	1.92	x	97.38	x	0.63	x	0.7	=	57.14	(75)
Northeast	0.9x	0.77	x	3.97	x	91.1	x	0.63	x	0.7	=	110.53	(75)
Northeast	0.9x	0.77	x	1.92	x	91.1	x	0.63	x	0.7	=	53.46	(75)
Northeast	0.9x	0.77	x	3.97	x	72.63	x	0.63	x	0.7	=	88.12	(75)
Northeast	0.9x	0.77	x	1.92	x	72.63	x	0.63	x	0.7	=	42.62	(75)
Northeast	0.9x	0.77	x	3.97	x	50.42	x	0.63	x	0.7	=	61.17	(75)
Northeast	0.9x	0.77	x	1.92	x	50.42	x	0.63	x	0.7	=	29.59	(75)
Northeast	0.9x	0.77	x	3.97	x	28.07	x	0.63	x	0.7	=	34.05	(75)
Northeast	0.9x	0.77	x	1.92	x	28.07	x	0.63	x	0.7	=	16.47	(75)
Northeast	0.9x	0.77	x	3.97	x	14.2	x	0.63	x	0.7	=	17.22	(75)
Northeast	0.9x	0.77	x	1.92	x	14.2	x	0.63	x	0.7	=	8.33	(75)
Northeast	0.9x	0.77	x	3.97	x	9.21	x	0.63	x	0.7	=	11.18	(75)
Northeast	0.9x	0.77	x	1.92	x	9.21	x	0.63	x	0.7	=	5.41	(75)
Northwest	0.9x	0.77	x	1.73	x	11.28	x	0.63	x	0.7	=	11.93	(81)
Northwest	0.9x	0.77	x	1.73	x	22.97	x	0.63	x	0.7	=	24.29	(81)
Northwest	0.9x	0.77	x	1.73	x	41.38	x	0.63	x	0.7	=	43.75	(81)
Northwest	0.9x	0.77	x	1.73	x	67.96	x	0.63	x	0.7	=	71.86	(81)
Northwest	0.9x	0.77	x	1.73	x	91.35	x	0.63	x	0.7	=	96.59	(81)
Northwest	0.9x	0.77	x	1.73	x	97.38	x	0.63	x	0.7	=	102.98	(81)
Northwest	0.9x	0.77	x	1.73	x	91.1	x	0.63	x	0.7	=	96.33	(81)
Northwest	0.9x	0.77	x	1.73	x	72.63	x	0.63	x	0.7	=	76.8	(81)
Northwest	0.9x	0.77	x	1.73	x	50.42	x	0.63	x	0.7	=	53.32	(81)
Northwest	0.9x	0.77	x	1.73	x	28.07	x	0.63	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	1.73	x	14.2	x	0.63	x	0.7	=	15.01	(81)
Northwest	0.9x	0.77	x	1.73	x	9.21	x	0.63	x	0.7	=	9.74	(81)
Rooflights	0.9x	1	x	0.44	x	26	x	0.63	x	0.7	=	4.5	(82)
Rooflights	0.9x	1	x	0.74	x	26	x	0.63	x	0.7	=	7.68	(82)
Rooflights	0.9x	1	x	0.44	x	54	x	0.63	x	0.7	=	9.36	(82)

Rooflights 0.9x	1	x	0.74	x	54	x	0.63	x	0.7	=	15.95	(82)
Rooflights 0.9x	1	x	0.44	x	96	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	0.74	x	96	x	0.63	x	0.7	=	28.35	(82)
Rooflights 0.9x	1	x	0.44	x	150	x	0.63	x	0.7	=	25.99	(82)
Rooflights 0.9x	1	x	0.74	x	150	x	0.63	x	0.7	=	44.3	(82)
Rooflights 0.9x	1	x	0.44	x	192	x	0.63	x	0.7	=	33.26	(82)
Rooflights 0.9x	1	x	0.74	x	192	x	0.63	x	0.7	=	56.71	(82)
Rooflights 0.9x	1	x	0.44	x	200	x	0.63	x	0.7	=	34.65	(82)
Rooflights 0.9x	1	x	0.74	x	200	x	0.63	x	0.7	=	59.07	(82)
Rooflights 0.9x	1	x	0.44	x	189	x	0.63	x	0.7	=	32.74	(82)
Rooflights 0.9x	1	x	0.74	x	189	x	0.63	x	0.7	=	55.82	(82)
Rooflights 0.9x	1	x	0.44	x	157	x	0.63	x	0.7	=	27.2	(82)
Rooflights 0.9x	1	x	0.74	x	157	x	0.63	x	0.7	=	46.37	(82)
Rooflights 0.9x	1	x	0.44	x	115	x	0.63	x	0.7	=	19.92	(82)
Rooflights 0.9x	1	x	0.74	x	115	x	0.63	x	0.7	=	33.96	(82)
Rooflights 0.9x	1	x	0.44	x	66	x	0.63	x	0.7	=	11.43	(82)
Rooflights 0.9x	1	x	0.74	x	66	x	0.63	x	0.7	=	19.49	(82)
Rooflights 0.9x	1	x	0.44	x	33	x	0.63	x	0.7	=	5.72	(82)
Rooflights 0.9x	1	x	0.74	x	33	x	0.63	x	0.7	=	9.75	(82)
Rooflights 0.9x	1	x	0.44	x	21	x	0.63	x	0.7	=	3.64	(82)
Rooflights 0.9x	1	x	0.74	x	21	x	0.63	x	0.7	=	6.2	(82)

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

(83)m=	44.42	90.93	163.22	264.47	350.99	371.99	348.88	281.1	197.96	111.13	56.03	36.17	(83)

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

(84)m=	325.02	369.35	431.51	516.86	587.52	592.98	559.95	497.45	422.59	351.83	315.11	308.9	(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	0.99	0.95	0.85	0.68	0.52	0.6	0.86	0.98	0.99	1	(86)

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

(87)m=	19.46	19.62	19.93	20.37	20.74	20.93	20.98	20.97	20.8	20.32	19.82	19.44	(87)

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

(88)m=	19.75	19.76	19.76	19.77	19.78	19.79	19.79	19.79	19.78	19.78	19.77	19.76	(88)

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

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.39	0.46	0.78	0.96	0.99	1	(89)

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

(90)m=	17.73	17.97	18.42	19.05	19.53	19.74	19.78	19.78	19.62	18.99	18.27	17.71	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(92)m=	18.55	18.75	19.13	19.67	20.1	20.31	20.35	20.34	20.18	19.62	19	18.53		(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate														
(93)m=	18.55	18.75	19.13	19.67	20.1	20.31	20.35	20.34	20.18	19.62	19	18.53		(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.99	0.98	0.93	0.81	0.62	0.45	0.53	0.81	0.96	0.99	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	323.29	365.81	421.4	479.8	475.86	367.64	252.85	261.36	342.46	338.65	312.15	307.58		(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=	1010.18	978.97	890.7	749.97	583.32	391.9	257.55	270.16	419.19	626.49	830.74	1004.92		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	511.05	412.05	349.16	194.52	79.95	0	0	0	0	214.16	373.39	518.83		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				2653.09	(98)
Space heating requirement in kWh/m²/year													52.88	(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) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(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)														
	511.05	412.05	349.16	194.52	79.95	0	0	0	0	214.16	373.39	518.83		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	547.16	441.16	373.83	208.26	85.6	0	0	0	0	229.29	399.77	555.49		
									Total (kWh/year) =Sum(211)$_{1...5,10...12}$=				2840.57	(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)														
	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37		
Efficiency of water heater													80.3	(216)
(217)m=	87.73	87.57	87.13	86.03	83.92	80.3	80.3	80.3	80.3	86.15	87.29	87.8		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	186.03	162.8	170.23	152.91	151.78	139.7	133.84	149.2	150.85	160.1	168.67	181.5		
									Total = Sum(219a)$_{1...12}$ =				1907.63	(219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2840.57	
Water heating fuel used			1907.63	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			232.82	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	613.56	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	412.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1025.61	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	120.84	(268)
Total CO2, kg/year		sum of (265)…(271) =		1185.37	(272)

TER = 23.63 (273)

TER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.25	(1a) x	2.7	(2a) =	159.98	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.25	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	159.98	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

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

(25)m=	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1	=	2			(26)
Windows Type 1			4.89	x1/[1/(1.4)+ 0.04]		=	6.48			(27)
Windows Type 2			2.49	x1/[1/(1.4)+ 0.04]		=	3.3			(27)
Windows Type 3			1.9	x1/[1/(1.4)+ 0.04]		=	2.52			(27)
Windows Type 4			2.58	x1/[1/(1.4)+ 0.04]		=	3.42			(27)
Rooflights			0.9523603	x1/[1/(1.7) + 0.04]		=	1.619012			(27b)
Walls Type1	38.95	11.86	27.09	x	0.18	=	4.88			(29)
Walls Type2	45.47	2	43.47	x	0.18	=	7.82			(29)
Roof	59.25	0.95	58.3	x	0.13	=	7.58			(30)
Total area of elements, m²			143.67							(31)
Party wall			25.95	x	0	=	0			(32)
Party floor			59.25							(32a)

** 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) = 39.52 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16820.08 (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 11.3 (36)

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

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Total fabric heat loss	(33) + (36) =	50.82 (37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.02	29.88	29.74	29.09	28.97	28.41	28.41	28.3	28.63	28.97	29.22	29.47	(38)

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

(39)m=	80.84	80.7	80.57	79.92	79.8	79.23	79.23	79.13	79.45	79.8	80.04	80.3	

Average = $Sum(39)_{1...12}$ /12= 79.92 (39)

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

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

Average = $Sum(40)_{1...12}$ /12= 1.35 (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 1.96 (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 80.76 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	88.83	85.6	82.37	79.14	75.91	72.68	72.68	75.91	79.14	82.37	85.6	88.83

Total = $Sum(44)_{1...12}$ = 969.1 (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=	131.74	115.22	118.9	103.66	99.46	85.83	79.53	91.26	92.35	107.63	117.49	127.58

Total = $Sum(45)_{1...12}$ = 1270.64 (45)

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

(46)m=	19.76	17.28	17.83	15.55	14.92	12.87	11.93	13.69	13.85	16.14	17.62	19.14	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	45.27	39.4	41.98	39.03	38.68	35.84	37.04	38.68	39.03	41.98	42.22	45.27	(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=	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85	(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=	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85

Output from water heater (annual)$_{1...12}$ 1755.06 (64)

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

(65)m=	55.12	48.16	50.03	44.22	42.74	37.5	35.7	40.02	40.46	46.28	49.62	53.74	(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=	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	(66)

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

(67)m=	15.26	13.55	11.02	8.34	6.24	5.26	5.69	7.39	9.92	12.6	14.71	15.68	(67)

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

(68)m=	171.05	172.83	168.35	158.83	146.81	135.51	127.97	126.19	130.66	140.19	152.21	163.5	(68)

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

(69)m=	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	(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=	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	(71)

Water heating gains (Table 5)

(72)m=	74.09	71.67	67.24	61.42	57.45	52.08	47.99	53.79	56.2	62.21	68.91	72.23	(72)

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

(73)m=	315.8	313.45	302.02	284	265.9	248.27	237.05	242.78	252.2	270.4	291.23	306.82	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.49	x	11.28	x	0.63	x	0.7	=	8.59	(75)
Northeast	0.9x	0.77	x	2.49	x	22.97	x	0.63	x	0.7	=	17.48	(75)
Northeast	0.9x	0.77	x	2.49	x	41.38	x	0.63	x	0.7	=	31.49	(75)
Northeast	0.9x	0.77	x	2.49	x	67.96	x	0.63	x	0.7	=	51.71	(75)
Northeast	0.9x	0.77	x	2.49	x	91.35	x	0.63	x	0.7	=	69.51	(75)
Northeast	0.9x	0.77	x	2.49	x	97.38	x	0.63	x	0.7	=	74.11	(75)
Northeast	0.9x	0.77	x	2.49	x	91.1	x	0.63	x	0.7	=	69.33	(75)
Northeast	0.9x	0.77	x	2.49	x	72.63	x	0.63	x	0.7	=	55.27	(75)
Northeast	0.9x	0.77	x	2.49	x	50.42	x	0.63	x	0.7	=	38.37	(75)
Northeast	0.9x	0.77	x	2.49	x	28.07	x	0.63	x	0.7	=	21.36	(75)
Northeast	0.9x	0.77	x	2.49	x	14.2	x	0.63	x	0.7	=	10.8	(75)
Northeast	0.9x	0.77	x	2.49	x	9.21	x	0.63	x	0.7	=	7.01	(75)
Northwest	0.9x	0.77	x	4.89	x	11.28	x	0.63	x	0.7	=	16.86	(81)
Northwest	0.9x	0.77	x	1.9	x	11.28	x	0.63	x	0.7	=	6.55	(81)
Northwest	0.9x	0.77	x	2.58	x	11.28	x	0.63	x	0.7	=	8.9	(81)
Northwest	0.9x	0.77	x	4.89	x	22.97	x	0.63	x	0.7	=	34.32	(81)
Northwest	0.9x	0.77	x	1.9	x	22.97	x	0.63	x	0.7	=	13.34	(81)
Northwest	0.9x	0.77	x	2.58	x	22.97	x	0.63	x	0.7	=	18.11	(81)
Northwest	0.9x	0.77	x	4.89	x	41.38	x	0.63	x	0.7	=	61.84	(81)
Northwest	0.9x	0.77	x	1.9	x	41.38	x	0.63	x	0.7	=	24.03	(81)
Northwest	0.9x	0.77	x	2.58	x	41.38	x	0.63	x	0.7	=	32.63	(81)
Northwest	0.9x	0.77	x	4.89	x	67.96	x	0.63	x	0.7	=	101.56	(81)
Northwest	0.9x	0.77	x	1.9	x	67.96	x	0.63	x	0.7	=	39.46	(81)
Northwest	0.9x	0.77	x	2.58	x	67.96	x	0.63	x	0.7	=	53.58	(81)
Northwest	0.9x	0.77	x	4.89	x	91.35	x	0.63	x	0.7	=	136.51	(81)
Northwest	0.9x	0.77	x	1.9	x	91.35	x	0.63	x	0.7	=	53.04	(81)
Northwest	0.9x	0.77	x	2.58	x	91.35	x	0.63	x	0.7	=	72.02	(81)
Northwest	0.9x	0.77	x	4.89	x	97.38	x	0.63	x	0.7	=	145.54	(81)
Northwest	0.9x	0.77	x	1.9	x	97.38	x	0.63	x	0.7	=	56.55	(81)
Northwest	0.9x	0.77	x	2.58	x	97.38	x	0.63	x	0.7	=	76.79	(81)
Northwest	0.9x	0.77	x	4.89	x	91.1	x	0.63	x	0.7	=	136.15	(81)
Northwest	0.9x	0.77	x	1.9	x	91.1	x	0.63	x	0.7	=	52.9	(81)
Northwest	0.9x	0.77	x	2.58	x	91.1	x	0.63	x	0.7	=	71.83	(81)
Northwest	0.9x	0.77	x	4.89	x	72.63	x	0.63	x	0.7	=	108.54	(81)
Northwest	0.9x	0.77	x	1.9	x	72.63	x	0.63	x	0.7	=	42.17	(81)
Northwest	0.9x	0.77	x	2.58	x	72.63	x	0.63	x	0.7	=	57.26	(81)
Northwest	0.9x	0.77	x	4.89	x	50.42	x	0.63	x	0.7	=	75.35	(81)
Northwest	0.9x	0.77	x	1.9	x	50.42	x	0.63	x	0.7	=	29.28	(81)
Northwest	0.9x	0.77	x	2.58	x	50.42	x	0.63	x	0.7	=	39.76	(81)

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Northwest 0.9x	0.77	x	4.89	x	28.07	x	0.63	x	0.7	=	41.94	(81)
Northwest 0.9x	0.77	x	1.9	x	28.07	x	0.63	x	0.7	=	16.3	(81)
Northwest 0.9x	0.77	x	2.58	x	28.07	x	0.63	x	0.7	=	22.13	(81)
Northwest 0.9x	0.77	x	4.89	x	14.2	x	0.63	x	0.7	=	21.22	(81)
Northwest 0.9x	0.77	x	1.9	x	14.2	x	0.63	x	0.7	=	8.24	(81)
Northwest 0.9x	0.77	x	2.58	x	14.2	x	0.63	x	0.7	=	11.19	(81)
Northwest 0.9x	0.77	x	4.89	x	9.21	x	0.63	x	0.7	=	13.77	(81)
Northwest 0.9x	0.77	x	1.9	x	9.21	x	0.63	x	0.7	=	5.35	(81)
Northwest 0.9x	0.77	x	2.58	x	9.21	x	0.63	x	0.7	=	7.27	(81)
Rooflights 0.9x	1	x	0.95	x	26	x	0.63	x	0.7	=	9.83	(82)
Rooflights 0.9x	1	x	0.95	x	54	x	0.63	x	0.7	=	20.41	(82)
Rooflights 0.9x	1	x	0.95	x	96	x	0.63	x	0.7	=	36.29	(82)
Rooflights 0.9x	1	x	0.95	x	150	x	0.63	x	0.7	=	56.7	(82)
Rooflights 0.9x	1	x	0.95	x	192	x	0.63	x	0.7	=	72.57	(82)
Rooflights 0.9x	1	x	0.95	x	200	x	0.63	x	0.7	=	75.6	(82)
Rooflights 0.9x	1	x	0.95	x	189	x	0.63	x	0.7	=	71.44	(82)
Rooflights 0.9x	1	x	0.95	x	157	x	0.63	x	0.7	=	59.34	(82)
Rooflights 0.9x	1	x	0.95	x	115	x	0.63	x	0.7	=	43.47	(82)
Rooflights 0.9x	1	x	0.95	x	66	x	0.63	x	0.7	=	24.95	(82)
Rooflights 0.9x	1	x	0.95	x	33	x	0.63	x	0.7	=	12.47	(82)
Rooflights 0.9x	1	x	0.95	x	21	x	0.63	x	0.7	=	7.94	(82)

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

(83)m=	50.72	103.66	186.27	303.01	403.66	428.58	401.64	322.59	226.22	126.68	63.93	41.34	(83)

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

(84)m=	366.52	417.11	488.29	587.01	669.57	676.84	638.69	565.36	478.42	397.08	355.17	348.15	(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	0.95	0.86	0.68	0.53	0.61	0.87	0.98	1	1	(86)

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

(87)m=	19.5	19.65	19.95	20.38	20.74	20.93	20.98	20.97	20.8	20.33	19.84	19.47	(87)

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

(88)m=	19.79	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.8	19.8	(88)

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

(89)m=	1	0.99	0.98	0.94	0.8	0.58	0.39	0.47	0.79	0.97	0.99	1	(89)

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

(90)m=	17.81	18.03	18.47	19.08	19.56	19.77	19.81	19.8	19.64	19.02	18.31	17.77	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

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

(92)m=	18.6	18.79	19.16	19.69	20.11	20.31	20.36	20.35	20.18	19.63	19.03	18.57	(92)

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

(93)m=	18.6	18.79	19.16	19.69	20.11	20.31	20.36	20.35	20.18	19.63	19.03	18.57	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.82	0.63	0.46	0.53	0.82	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	364.91	413.7	478.19	548.08	547.08	424.63	292.27	302.07	392.63	383.9	352.35	346.93	(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=	1155.97	1120.9	1020.3	862.09	671.17	452.64	297.62	312.35	483.25	720.61	954.7	1153.54	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	588.55	475.23	403.33	226.09	92.32	0	0	0	0	250.51	433.69	600.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3069.84 (98)

Space heating requirement in kWh/m²/year 51.81 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(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)													
	588.55	475.23	403.33	226.09	92.32	0	0	0	0	250.51	433.69	600.12	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	630.14	508.81	431.84	242.06	98.84	0	0	0	0	268.21	464.34	642.53	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3286.77 (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)													
	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85	
Efficiency of water heater												80.3	(216)
(217)m=	87.85	87.69	87.27	86.2	84.06	80.3	80.3	80.3	80.3	86.34	87.44	87.93	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	201.5	176.32	184.34	165.52	164.34	151.52	145.17	161.83	163.62	173.28	182.64	196.58	

Total = Sum(219a)$_{1...12}$ = 2066.65 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			3286.77	
Water heating fuel used			2066.65	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			269.42	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	709.94	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	446.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1156.34	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	139.83	(268)
Total CO2, kg/year			sum of (265)…(271) =		1335.09	(272)

TER =	22.53	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	72.85	(1a) x	2.7	(2a) =	196.69	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.85	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	196.69	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.4	0.39	0.38	0.34	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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	=	2			(26)
Windows Type 1			4.25	x1/[1/(1.4)+ 0.04]		=	5.63			(27)
Windows Type 2			5.9	x1/[1/(1.4)+ 0.04]		=	7.82			(27)
Windows Type 3			4.47	x1/[1/(1.4)+ 0.04]		=	5.93			(27)
Windows Type 4			0.91	x1/[1/(1.4)+ 0.04]		=	1.21			(27)
Rooflights			0.6817503	x1/[1/(1.7) + 0.04]		=	1.158975			(27b)
Walls Type1	40.58	15.53	25.05	x	0.18	=	4.51			(29)
Walls Type2	56.98	2	54.98	x	0.18	=	9.9			(29)
Roof	72.85	0.68	72.17	x	0.13	=	9.38			(30)
Total area of elements, m²			170.41							(31)
Party wall			23.2	x	0	=	0			(32)
Party floor			72.85							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 47.46 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 19233.21 (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 12.16 (36)

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

TER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	59.63	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.59	37.39	37.19	36.28	36.1	35.31	35.31	35.16	35.61	36.1	36.45	36.82	(38)

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

(39)m=	97.21	97.02	96.82	95.9	95.73	94.93	94.93	94.78	95.24	95.73	96.08	96.44	

Average = Sum(39)$_{1…12}$ /12= 95.9 (39)

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

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

Average = Sum(40)$_{1…12}$ /12= 1.32 (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 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 89.14 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	98.05	94.49	90.92	87.36	83.79	80.23	80.23	83.79	87.36	90.92	94.49	98.05

Total = Sum(44)$_{1…12}$ = 1069.69 (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=	145.41	127.18	131.24	114.42	109.78	94.74	87.79	100.74	101.94	118.8	129.68	140.82

Total = Sum(45)$_{1…12}$ = 1402.53 (45)

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

(46)m=	21.81	19.08	19.69	17.16	16.47	14.21	13.17	15.11	15.29	17.82	19.45	21.12	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	49.97	43.49	46.33	43.08	42.7	39.56	40.88	42.7	43.08	46.33	46.6	49.97	(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=	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79

Output from water heater (annual)$_{1...12}$ | 1937.22 | (64)

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

(65)m=	60.84	53.16	55.22	48.81	47.18	41.39	39.41	44.17	44.66	51.08	54.77	59.32	(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=	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	(66)

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

(67)m=	18.17	16.14	13.13	9.94	7.43	6.27	6.78	8.81	11.82	15.01	17.52	18.68	(67)

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

(68)m=	203.86	205.97	200.64	189.29	174.97	161.5	152.51	150.39	155.72	167.07	181.4	194.86	(68)

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

(69)m=	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	(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=	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	(71)

Water heating gains (Table 5)

(72)m=	81.78	79.11	74.22	67.8	63.41	57.49	52.97	59.37	62.03	68.66	76.07	79.73	(72)

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

(73)m=	364.5	361.92	348.68	327.72	306.51	285.96	272.95	279.27	290.28	311.44	335.68	353.96	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	0.91	x	11.28	x	0.63	x	0.7	=	3.14	(75)
Northeast	0.9x	0.77	x	0.91	x	22.97	x	0.63	x	0.7	=	6.39	(75)
Northeast	0.9x	0.77	x	0.91	x	41.38	x	0.63	x	0.7	=	11.51	(75)
Northeast	0.9x	0.77	x	0.91	x	67.96	x	0.63	x	0.7	=	18.9	(75)
Northeast	0.9x	0.77	x	0.91	x	91.35	x	0.63	x	0.7	=	25.4	(75)
Northeast	0.9x	0.77	x	0.91	x	97.38	x	0.63	x	0.7	=	27.08	(75)
Northeast	0.9x	0.77	x	0.91	x	91.1	x	0.63	x	0.7	=	25.34	(75)
Northeast	0.9x	0.77	x	0.91	x	72.63	x	0.63	x	0.7	=	20.2	(75)
Northeast	0.9x	0.77	x	0.91	x	50.42	x	0.63	x	0.7	=	14.02	(75)
Northeast	0.9x	0.77	x	0.91	x	28.07	x	0.63	x	0.7	=	7.81	(75)
Northeast	0.9x	0.77	x	0.91	x	14.2	x	0.63	x	0.7	=	3.95	(75)
Northeast	0.9x	0.77	x	0.91	x	9.21	x	0.63	x	0.7	=	2.56	(75)
Southeast	0.9x	0.77	x	4.25	x	36.79	x	0.63	x	0.7	=	47.79	(77)
Southeast	0.9x	0.77	x	5.9	x	36.79	x	0.63	x	0.7	=	66.34	(77)
Southeast	0.9x	0.77	x	4.47	x	36.79	x	0.63	x	0.7	=	50.26	(77)
Southeast	0.9x	0.77	x	4.25	x	62.67	x	0.63	x	0.7	=	81.4	(77)
Southeast	0.9x	0.77	x	5.9	x	62.67	x	0.63	x	0.7	=	113.01	(77)
Southeast	0.9x	0.77	x	4.47	x	62.67	x	0.63	x	0.7	=	85.62	(77)
Southeast	0.9x	0.77	x	4.25	x	85.75	x	0.63	x	0.7	=	111.38	(77)
Southeast	0.9x	0.77	x	5.9	x	85.75	x	0.63	x	0.7	=	154.62	(77)
Southeast	0.9x	0.77	x	4.47	x	85.75	x	0.63	x	0.7	=	117.15	(77)
Southeast	0.9x	0.77	x	4.25	x	106.25	x	0.63	x	0.7	=	138.01	(77)
Southeast	0.9x	0.77	x	5.9	x	106.25	x	0.63	x	0.7	=	191.58	(77)
Southeast	0.9x	0.77	x	4.47	x	106.25	x	0.63	x	0.7	=	145.15	(77)
Southeast	0.9x	0.77	x	4.25	x	119.01	x	0.63	x	0.7	=	154.58	(77)
Southeast	0.9x	0.77	x	5.9	x	119.01	x	0.63	x	0.7	=	214.59	(77)
Southeast	0.9x	0.77	x	4.47	x	119.01	x	0.63	x	0.7	=	162.58	(77)
Southeast	0.9x	0.77	x	4.25	x	118.15	x	0.63	x	0.7	=	153.46	(77)
Southeast	0.9x	0.77	x	5.9	x	118.15	x	0.63	x	0.7	=	213.04	(77)
Southeast	0.9x	0.77	x	4.47	x	118.15	x	0.63	x	0.7	=	161.4	(77)
Southeast	0.9x	0.77	x	4.25	x	113.91	x	0.63	x	0.7	=	147.95	(77)
Southeast	0.9x	0.77	x	5.9	x	113.91	x	0.63	x	0.7	=	205.39	(77)
Southeast	0.9x	0.77	x	4.47	x	113.91	x	0.63	x	0.7	=	155.61	(77)
Southeast	0.9x	0.77	x	4.25	x	104.39	x	0.63	x	0.7	=	135.59	(77)
Southeast	0.9x	0.77	x	5.9	x	104.39	x	0.63	x	0.7	=	188.23	(77)
Southeast	0.9x	0.77	x	4.47	x	104.39	x	0.63	x	0.7	=	142.61	(77)
Southeast	0.9x	0.77	x	4.25	x	92.85	x	0.63	x	0.7	=	120.6	(77)
Southeast	0.9x	0.77	x	5.9	x	92.85	x	0.63	x	0.7	=	167.42	(77)
Southeast	0.9x	0.77	x	4.47	x	92.85	x	0.63	x	0.7	=	126.84	(77)

Southeast 0.9x	0.77	x	4.25	x	69.27	x	0.63	x	0.7	=	89.97	(77)
Southeast 0.9x	0.77	x	5.9	x	69.27	x	0.63	x	0.7	=	124.9	(77)
Southeast 0.9x	0.77	x	4.47	x	69.27	x	0.63	x	0.7	=	94.63	(77)
Southeast 0.9x	0.77	x	4.25	x	44.07	x	0.63	x	0.7	=	57.24	(77)
Southeast 0.9x	0.77	x	5.9	x	44.07	x	0.63	x	0.7	=	79.46	(77)
Southeast 0.9x	0.77	x	4.47	x	44.07	x	0.63	x	0.7	=	60.2	(77)
Southeast 0.9x	0.77	x	4.25	x	31.49	x	0.63	x	0.7	=	40.9	(77)
Southeast 0.9x	0.77	x	5.9	x	31.49	x	0.63	x	0.7	=	56.78	(77)
Southeast 0.9x	0.77	x	4.47	x	31.49	x	0.63	x	0.7	=	43.02	(77)
Rooflights 0.9x	1	x	0.68	x	26	x	0.63	x	0.7	=	7.04	(82)
Rooflights 0.9x	1	x	0.68	x	54	x	0.63	x	0.7	=	14.61	(82)
Rooflights 0.9x	1	x	0.68	x	96	x	0.63	x	0.7	=	25.98	(82)
Rooflights 0.9x	1	x	0.68	x	150	x	0.63	x	0.7	=	40.59	(82)
Rooflights 0.9x	1	x	0.68	x	192	x	0.63	x	0.7	=	51.95	(82)
Rooflights 0.9x	1	x	0.68	x	200	x	0.63	x	0.7	=	54.12	(82)
Rooflights 0.9x	1	x	0.68	x	189	x	0.63	x	0.7	=	51.14	(82)
Rooflights 0.9x	1	x	0.68	x	157	x	0.63	x	0.7	=	42.48	(82)
Rooflights 0.9x	1	x	0.68	x	115	x	0.63	x	0.7	=	31.12	(82)
Rooflights 0.9x	1	x	0.68	x	66	x	0.63	x	0.7	=	17.86	(82)
Rooflights 0.9x	1	x	0.68	x	33	x	0.63	x	0.7	=	8.93	(82)
Rooflights 0.9x	1	x	0.68	x	21	x	0.63	x	0.7	=	5.68	(82)

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

(83)m=	174.57	301.03	420.63	534.23	609.1	609.1	585.43	529.1	460.01	335.16	209.79	148.93	(83)

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

(84)m=	539.07	662.94	769.32	861.95	915.61	895.06	858.38	808.37	750.29	646.6	545.47	502.9	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.92	0.81	0.64	0.48	0.52	0.76	0.95	0.99	1	(86)

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

(87)m=	19.64	19.87	20.18	20.54	20.81	20.95	20.99	20.98	20.89	20.52	20	19.6	(87)

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

(88)m=	19.81	19.82	19.82	19.83	19.83	19.84	19.84	19.84	19.84	19.83	19.83	19.82	(88)

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

(89)m=	0.99	0.98	0.96	0.89	0.75	0.54	0.36	0.4	0.67	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=	18.04	18.36	18.81	19.31	19.66	19.81	19.84	19.83	19.76	19.3	18.57	17.98	(90)

fLA = Living area ÷ (4) = 0.45 (91)

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

(92)m=	18.76	19.04	19.42	19.86	20.17	20.32	20.35	20.35	20.27	19.85	19.21	18.71	(92)

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

(93)m=	18.76	19.04	19.42	19.86	20.17	20.32	20.35	20.35	20.27	19.85	19.21	18.71	(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	0.89	0.77	0.58	0.41	0.46	0.71	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	534.46	649.47	733.32	766.78	701.46	519.67	352.33	368.2	530.72	595.47	535.82	499.65	(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=	1405.37	1371.43	1250.97	1051.05	811.13	543.09	356.15	374.29	587.16	885.12	1163.74	1398.98	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	647.95	485.16	385.13	204.68	81.6	0	0	0	0	215.51	452.1	669.1	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3141.22 (98)

Space heating requirement in kWh/m²/year 43.12 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(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)													
	647.95	485.16	385.13	204.68	81.6	0	0	0	0	215.51	452.1	669.1	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	693.74	519.44	412.34	219.14	87.36	0	0	0	0	230.73	484.05	716.38	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 3363.2 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79

Efficiency of water heater 80.3 (216)

(217)m=	87.84	87.53	86.95	85.71	83.55	80.3	80.3	80.3	80.3	85.72	87.32	87.95	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.43	194.97	204.22	183.75	182.5	167.25	160.23	178.62	180.6	192.64	201.88	216.94

Total = $Sum(219a)_{1...12}$ = 2286.03 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3363.2	
Water heating fuel used			2286.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			320.92	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	726.45	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	493.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1220.23	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	166.56	(268)
Total CO2, kg/year		sum of (265)…(271) =		1425.72	(272)

TER =	19.57	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.4	(1a) x	2.7	(2a) =	165.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.4	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		165.78	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(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) =	20	÷ (5) =	0.12	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.32	(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
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

TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(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	=	2			(26)
Windows Type 1			1.69	x1/[1/(1.4)+ 0.04]		=	2.24			(27)
Windows Type 2			0.42	x1/[1/(1.4)+ 0.04]		=	0.56			(27)
Windows Type 3			2.87	x1/[1/(1.4)+ 0.04]		=	3.8			(27)
Windows Type 4			3.82	x1/[1/(1.4)+ 0.04]		=	5.06			(27)
Windows Type 5			2.87	x1/[1/(1.4)+ 0.04]		=	3.8			(27)
Walls Type1	51.43	13.36	38.07	x	0.18	=	6.85			(29)
Walls Type2	35.95	2	33.95	x	0.18	=	6.11			(29)
Roof	61.4	0	61.4	x	0.13	=	7.98			(30)
Total area of elements, m²			148.78							(31)
Party wall			17.92	x	0	=	0			(32)
Party floor			61.4							(32a)

** 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) = 40.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17050.8 (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 12.52 (36)

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

Total fabric heat loss (33) + (36) = 53.18 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.77	31.6	31.43	30.64	30.49	29.8	29.8	29.68	30.07	30.49	30.79	31.1	(38)

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

(39)m=	84.95	84.77	84.61	83.82	83.67	82.98	82.98	82.85	83.25	83.67	83.97	84.28	

Average = $Sum(39)_{1...12}$ /12= 83.82 (39)

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

(40)m=	1.38	1.38	1.38	1.37	1.36	1.35	1.35	1.35	1.36	1.36	1.37	1.37	

Average = $Sum(40)_{1...12}$ /12= 1.37 (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 2.02 (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 82.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	90.42	87.13	83.84	80.55	77.27	73.98	73.98	77.27	80.55	83.84	87.13	90.42	

Total = $Sum(44)_{1...12}$ = 986.36 (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=	134.09	117.27	121.01	105.5	101.23	87.36	80.95	92.89	94	109.55	119.58	129.85	

Total = $Sum(45)_{1...12}$ = 1293.28 (45)

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

(46)m=	20.11	17.59	18.15	15.83	15.18	13.1	12.14	13.93	14.1	16.43	17.94	19.48	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	46.08	40.1	42.72	39.72	39.37	36.48	37.7	39.37	39.72	42.72	42.97	46.08	(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=	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93	(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=	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93

Output from water heater (annual)$_{1…12}$ 1786.33 (64)

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

(65)m=	56.1	49.02	50.92	45.01	43.5	38.17	36.34	40.73	41.19	47.11	50.5	54.7	(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=	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	(66)

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

(67)m=	15.74	13.98	11.37	8.61	6.44	5.43	5.87	7.63	10.24	13.01	15.18	16.18	(67)

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

(68)m=	176.46	178.29	173.68	163.86	151.46	139.8	132.02	130.18	134.8	144.62	157.02	168.68	(68)

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

(69)m=	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	(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=	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	(71)

Water heating gains (Table 5)

(72)m=	75.41	72.94	68.44	62.52	58.47	53.01	48.84	54.74	57.2	63.31	70.14	73.52	(72)

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

(73)m=	323.93	321.54	309.8	291.3	272.68	254.56	243.04	248.87	258.56	277.25	298.66	314.69	(73)

6. Solar gains:

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

TER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest	0.9x	0.77	x	3.82	x	36.79		0.63	x	0.7	=	42.95	(79)
Southwest	0.9x	0.77	x	2.87	x	36.79		0.63	x	0.7	=	32.27	(79)
Southwest	0.9x	0.77	x	3.82	x	62.67		0.63	x	0.7	=	73.17	(79)
Southwest	0.9x	0.77	x	2.87	x	62.67		0.63	x	0.7	=	54.97	(79)
Southwest	0.9x	0.77	x	3.82	x	85.75		0.63	x	0.7	=	100.11	(79)
Southwest	0.9x	0.77	x	2.87	x	85.75		0.63	x	0.7	=	75.21	(79)
Southwest	0.9x	0.77	x	3.82	x	106.25		0.63	x	0.7	=	124.04	(79)
Southwest	0.9x	0.77	x	2.87	x	106.25		0.63	x	0.7	=	93.19	(79)
Southwest	0.9x	0.77	x	3.82	x	119.01		0.63	x	0.7	=	138.94	(79)
Southwest	0.9x	0.77	x	2.87	x	119.01		0.63	x	0.7	=	104.39	(79)
Southwest	0.9x	0.77	x	3.82	x	118.15		0.63	x	0.7	=	137.93	(79)
Southwest	0.9x	0.77	x	2.87	x	118.15		0.63	x	0.7	=	103.63	(79)
Southwest	0.9x	0.77	x	3.82	x	113.91		0.63	x	0.7	=	132.98	(79)
Southwest	0.9x	0.77	x	2.87	x	113.91		0.63	x	0.7	=	99.91	(79)
Southwest	0.9x	0.77	x	3.82	x	104.39		0.63	x	0.7	=	121.87	(79)
Southwest	0.9x	0.77	x	2.87	x	104.39		0.63	x	0.7	=	91.56	(79)
Southwest	0.9x	0.77	x	3.82	x	92.85		0.63	x	0.7	=	108.4	(79)
Southwest	0.9x	0.77	x	2.87	x	92.85		0.63	x	0.7	=	81.44	(79)
Southwest	0.9x	0.77	x	3.82	x	69.27		0.63	x	0.7	=	80.87	(79)
Southwest	0.9x	0.77	x	2.87	x	69.27		0.63	x	0.7	=	60.76	(79)
Southwest	0.9x	0.77	x	3.82	x	44.07		0.63	x	0.7	=	51.45	(79)
Southwest	0.9x	0.77	x	2.87	x	44.07		0.63	x	0.7	=	38.65	(79)
Southwest	0.9x	0.77	x	3.82	x	31.49		0.63	x	0.7	=	36.76	(79)
Southwest	0.9x	0.77	x	2.87	x	31.49		0.63	x	0.7	=	27.62	(79)
Northwest	0.9x	0.77	x	1.69	x	11.28	x	0.63	x	0.7	=	11.65	(81)
Northwest	0.9x	0.77	x	0.42	x	11.28	x	0.63	x	0.7	=	1.45	(81)
Northwest	0.9x	0.77	x	2.87	x	11.28	x	0.63	x	0.7	=	9.9	(81)
Northwest	0.9x	0.77	x	1.69	x	22.97	x	0.63	x	0.7	=	23.72	(81)
Northwest	0.9x	0.77	x	0.42	x	22.97	x	0.63	x	0.7	=	2.95	(81)
Northwest	0.9x	0.77	x	2.87	x	22.97	x	0.63	x	0.7	=	20.14	(81)
Northwest	0.9x	0.77	x	1.69	x	41.38	x	0.63	x	0.7	=	42.74	(81)
Northwest	0.9x	0.77	x	0.42	x	41.38	x	0.63	x	0.7	=	5.31	(81)
Northwest	0.9x	0.77	x	2.87	x	41.38	x	0.63	x	0.7	=	36.29	(81)
Northwest	0.9x	0.77	x	1.69	x	67.96	x	0.63	x	0.7	=	70.2	(81)
Northwest	0.9x	0.77	x	0.42	x	67.96	x	0.63	x	0.7	=	8.72	(81)
Northwest	0.9x	0.77	x	2.87	x	67.96	x	0.63	x	0.7	=	59.6	(81)
Northwest	0.9x	0.77	x	1.69	x	91.35	x	0.63	x	0.7	=	94.36	(81)
Northwest	0.9x	0.77	x	0.42	x	91.35	x	0.63	x	0.7	=	11.72	(81)
Northwest	0.9x	0.77	x	2.87	x	91.35	x	0.63	x	0.7	=	80.12	(81)

Northwest 0.9x	0.77	x	1.69	x	97.38	x	0.63	x	0.7	=	100.6	(81)
Northwest 0.9x	0.77	x	0.42	x	97.38	x	0.63	x	0.7	=	12.5	(81)
Northwest 0.9x	0.77	x	2.87	x	97.38	x	0.63	x	0.7	=	85.42	(81)
Northwest 0.9x	0.77	x	1.69	x	91.1	x	0.63	x	0.7	=	94.1	(81)
Northwest 0.9x	0.77	x	0.42	x	91.1	x	0.63	x	0.7	=	11.69	(81)
Northwest 0.9x	0.77	x	2.87	x	91.1	x	0.63	x	0.7	=	79.91	(81)
Northwest 0.9x	0.77	x	1.69	x	72.63	x	0.63	x	0.7	=	75.02	(81)
Northwest 0.9x	0.77	x	0.42	x	72.63	x	0.63	x	0.7	=	9.32	(81)
Northwest 0.9x	0.77	x	2.87	x	72.63	x	0.63	x	0.7	=	63.7	(81)
Northwest 0.9x	0.77	x	1.69	x	50.42	x	0.63	x	0.7	=	52.08	(81)
Northwest 0.9x	0.77	x	0.42	x	50.42	x	0.63	x	0.7	=	6.47	(81)
Northwest 0.9x	0.77	x	2.87	x	50.42	x	0.63	x	0.7	=	44.22	(81)
Northwest 0.9x	0.77	x	1.69	x	28.07	x	0.63	x	0.7	=	28.99	(81)
Northwest 0.9x	0.77	x	0.42	x	28.07	x	0.63	x	0.7	=	3.6	(81)
Northwest 0.9x	0.77	x	2.87	x	28.07	x	0.63	x	0.7	=	24.62	(81)
Northwest 0.9x	0.77	x	1.69	x	14.2	x	0.63	x	0.7	=	14.66	(81)
Northwest 0.9x	0.77	x	0.42	x	14.2	x	0.63	x	0.7	=	1.82	(81)
Northwest 0.9x	0.77	x	2.87	x	14.2	x	0.63	x	0.7	=	12.45	(81)
Northwest 0.9x	0.77	x	1.69	x	9.21	x	0.63	x	0.7	=	9.52	(81)
Northwest 0.9x	0.77	x	0.42	x	9.21	x	0.63	x	0.7	=	1.18	(81)
Northwest 0.9x	0.77	x	2.87	x	9.21	x	0.63	x	0.7	=	8.08	(81)

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

(83)m=	98.23	174.96	259.67	355.76	429.53	440.08	418.6	361.48	292.62	198.83	119.04	83.16	(83)

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

(84)m=	422.15	496.49	569.48	647.06	702.2	694.63	661.64	610.35	551.18	476.09	417.7	397.85	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.85	0.69	0.53	0.59	0.83	0.97	0.99	1	(86)

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

(87)m=	19.54	19.72	20.02	20.41	20.74	20.93	20.98	20.97	20.83	20.4	19.89	19.5	(87)

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

(88)m=	19.78	19.78	19.78	19.79	19.79	19.8	19.8	19.8	19.8	19.79	19.79	19.78	(88)

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

(89)m=	1	0.99	0.97	0.92	0.8	0.59	0.4	0.45	0.75	0.95	0.99	1	(89)

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

(90)m=	17.85	18.12	18.56	19.11	19.54	19.75	19.79	19.79	19.67	19.11	18.38	17.81	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	18.69	18.92	19.28	19.76	20.14	20.34	20.39	20.38	20.24	19.75	19.13	18.65	(92)

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

(93)m=	18.69	18.92	19.28	19.76	20.14	20.34	20.39	20.38	20.24	19.75	19.13	18.65	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.82	0.64	0.47	0.52	0.78	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.42	489.96	552.48	597.31	573.62	443.82	307.92	319.41	431.92	451.93	412.57	395.83	(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=	1222.44	1188.32	1081.61	909.93	705.94	476.13	314.13	329.66	511.5	765.55	1010.54	1218.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	597.45	469.3	393.67	225.08	98.45	0	0	0	0	233.33	430.54	611.7	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3059.52 (98)

Space heating requirement in kWh/m²/year 49.83 (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		93.4	(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)													
	597.45	469.3	393.67	225.08	98.45	0	0	0	0	233.33	430.54	611.7	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	639.66	502.46	421.49	240.99	105.4	0	0	0	0	249.82	460.96	654.93	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3275.71 (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)													
	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93	
Efficiency of water heater												80.3	(216)
(217)m=	87.84	87.63	87.18	86.15	84.17	80.3	80.3	80.3	80.3	86.12	87.39	87.93	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	205.1	179.59	187.82	168.57	167.04	154.22	147.75	164.71	166.53	176.81	186.01	200.08	

Total = Sum(219a)$_{1...12}$ = 2104.23 (219)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3275.71	
Water heating fuel used			2104.23	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			278.04	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	707.55	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	454.51	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1162.07	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	144.3	(268)
Total CO2, kg/year			sum of (265)…(271) =		1345.29	(272)

TER = 21.91 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.4	(1a) x	2.7	(2a) =	203.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.58	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.15	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.37	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.47	0.46	0.45	0.4	0.4	0.35	0.35	0.34	0.37	0.4	0.41	0.43

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(24d)

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

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59	(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	=	2			(26)
Windows Type 1			0.93	x1/[1/(1.4)+ 0.04]		=	1.23			(27)
Windows Type 2			1.98	x1/[1/(1.4)+ 0.04]		=	2.62			(27)
Windows Type 3			1.63	x1/[1/(1.4)+ 0.04]		=	2.16			(27)
Windows Type 4			2.04	x1/[1/(1.4)+ 0.04]		=	2.7			(27)
Windows Type 5			5.69	x1/[1/(1.4)+ 0.04]		=	7.54			(27)
Windows Type 6			0.87	x1/[1/(1.4)+ 0.04]		=	1.15			(27)
Windows Type 7			1.47	x1/[1/(1.4)+ 0.04]		=	1.95			(27)
Rooflights			0.7705792	x1/[1/(1.7) + 0.04]		=	1.309985			(27b)
Walls Type1	68.45	16.08	52.37	x	0.18	=	9.43			(29)
Walls Type2	4.03	2	2.03	x	0.18	=	0.37			(29)
Roof	75.4	0.77	74.63	x	0.13	=	9.7			(30)
Total area of elements, m²			147.88							(31)
Party wall			42.95	x	0	=	0			(32)
Party floor			75.4							(32a)

** 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) = 44.04 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14882.66 (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 | 14.96 | (36)

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

Total fabric heat loss (33) + (36) = | 59 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.97	40.68	40.4	39.08	38.84	37.69	37.69	37.47	38.13	38.84	39.33	39.86	(38)

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

(39)m=	99.96	99.68	99.4	98.08	97.83	96.68	96.68	96.47	97.12	97.83	98.33	98.85	

Average = $Sum(39)_{1...12}$ /12= | 98.08 | (39)

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

(40)m=	1.33	1.32	1.32	1.3	1.3	1.28	1.28	1.28	1.29	1.3	1.3	1.31

Average = $Sum(40)_{1...12}$ /12= | 1.3 | (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 | 2.37 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 90.48 | (43)

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

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

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

(44)m=	99.53	95.91	92.29	88.67	85.05	81.43	81.43	85.05	88.67	92.29	95.91	99.53

Total = $Sum(44)_{1...12}$ = | 1085.79 | (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=	147.6	129.09	133.21	116.14	111.44	96.16	89.11	102.25	103.47	120.59	131.63	142.94

Total = $Sum(45)_{1...12}$ = | 1423.64 | (45)

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

(46)m=	22.14	19.36	19.98	17.42	16.72	14.42	13.37	15.34	15.52	18.09	19.74	21.44	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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Energy lost from water storage, kWh/year	(47) 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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	50.72	44.15	47.03	43.73	43.34	40.16	41.5	43.34	43.73	47.03	47.3	50.72	(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=	198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66	(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=	198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66	

Output from water heater (annual)$_{1...12}$ | 1966.39 | (64)

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

(65)m=	61.76	53.96	56.05	49.55	47.89	42.01	40	44.83	45.34	51.85	55.59	60.21	(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=	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	(66)

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

(67)m=	18.68	16.59	13.49	10.21	7.64	6.45	6.97	9.05	12.15	15.43	18.01	19.2	(67)

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

(68)m=	209.56	211.73	206.25	194.59	179.86	166.02	156.78	154.6	160.08	171.75	186.47	200.31	(68)

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

(69)m=	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	(71)

Water heating gains (Table 5)

(72)m=	83.01	80.3	75.34	68.82	64.37	58.35	53.77	60.26	62.97	69.7	77.21	80.93	(72)

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

(73)m=	372.79	370.17	356.63	335.17	313.41	292.37	279.05	285.46	296.75	318.42	343.24	361.98	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m^2		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	5.69	x	11.28	x	0.63	x	0.7	=	19.62	(75)
Northeast	0.9x	0.77	x	0.87	x	11.28	x	0.63	x	0.7	=	3	(75)
Northeast	0.9x	0.77	x	5.69	x	22.97	x	0.63	x	0.7	=	39.94	(75)
Northeast	0.9x	0.77	x	0.87	x	22.97	x	0.63	x	0.7	=	6.11	(75)
Northeast	0.9x	0.77	x	5.69	x	41.38	x	0.63	x	0.7	=	71.96	(75)
Northeast	0.9x	0.77	x	0.87	x	41.38	x	0.63	x	0.7	=	11	(75)
Northeast	0.9x	0.77	x	5.69	x	67.96	x	0.63	x	0.7	=	118.17	(75)
Northeast	0.9x	0.77	x	0.87	x	67.96	x	0.63	x	0.7	=	18.07	(75)
Northeast	0.9x	0.77	x	5.69	x	91.35	x	0.63	x	0.7	=	158.84	(75)
Northeast	0.9x	0.77	x	0.87	x	91.35	x	0.63	x	0.7	=	24.29	(75)
Northeast	0.9x	0.77	x	5.69	x	97.38	x	0.63	x	0.7	=	169.35	(75)
Northeast	0.9x	0.77	x	0.87	x	97.38	x	0.63	x	0.7	=	25.89	(75)
Northeast	0.9x	0.77	x	5.69	x	91.1	x	0.63	x	0.7	=	158.42	(75)
Northeast	0.9x	0.77	x	0.87	x	91.1	x	0.63	x	0.7	=	24.22	(75)
Northeast	0.9x	0.77	x	5.69	x	72.63	x	0.63	x	0.7	=	126.29	(75)
Northeast	0.9x	0.77	x	0.87	x	72.63	x	0.63	x	0.7	=	19.31	(75)
Northeast	0.9x	0.77	x	5.69	x	50.42	x	0.63	x	0.7	=	87.68	(75)
Northeast	0.9x	0.77	x	0.87	x	50.42	x	0.63	x	0.7	=	13.41	(75)
Northeast	0.9x	0.77	x	5.69	x	28.07	x	0.63	x	0.7	=	48.81	(75)
Northeast	0.9x	0.77	x	0.87	x	28.07	x	0.63	x	0.7	=	7.46	(75)
Northeast	0.9x	0.77	x	5.69	x	14.2	x	0.63	x	0.7	=	24.69	(75)
Northeast	0.9x	0.77	x	0.87	x	14.2	x	0.63	x	0.7	=	3.77	(75)
Northeast	0.9x	0.77	x	5.69	x	9.21	x	0.63	x	0.7	=	16.02	(75)
Northeast	0.9x	0.77	x	0.87	x	9.21	x	0.63	x	0.7	=	2.45	(75)
Southeast	0.9x	0.77	x	1.47	x	36.79	x	0.63	x	0.7	=	33.06	(77)
Southeast	0.9x	0.77	x	1.47	x	62.67	x	0.63	x	0.7	=	56.31	(77)
Southeast	0.9x	0.77	x	1.47	x	85.75	x	0.63	x	0.7	=	77.05	(77)
Southeast	0.9x	0.77	x	1.47	x	106.25	x	0.63	x	0.7	=	95.47	(77)
Southeast	0.9x	0.77	x	1.47	x	119.01	x	0.63	x	0.7	=	106.93	(77)
Southeast	0.9x	0.77	x	1.47	x	118.15	x	0.63	x	0.7	=	106.16	(77)
Southeast	0.9x	0.77	x	1.47	x	113.91	x	0.63	x	0.7	=	102.35	(77)
Southeast	0.9x	0.77	x	1.47	x	104.39	x	0.63	x	0.7	=	93.8	(77)
Southeast	0.9x	0.77	x	1.47	x	92.85	x	0.63	x	0.7	=	83.43	(77)
Southeast	0.9x	0.77	x	1.47	x	69.27	x	0.63	x	0.7	=	62.24	(77)
Southeast	0.9x	0.77	x	1.47	x	44.07	x	0.63	x	0.7	=	39.6	(77)
Southeast	0.9x	0.77	x	1.47	x	31.49	x	0.63	x	0.7	=	28.29	(77)
Southwest	0.9x	0.77	x	0.93	x	36.79		0.63	x	0.7	=	10.46	(79)
Southwest	0.9x	0.77	x	1.98	x	36.79		0.63	x	0.7	=	22.26	(79)
Southwest	0.9x	0.77	x	1.63	x	36.79		0.63	x	0.7	=	18.33	(79)

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Southwest	0.9x	0.77	x	2.04	x	36.79	0.63	x	0.7	=	22.94	(79)
Southwest	0.9x	0.77	x	0.93	x	62.67	0.63	x	0.7	=	17.81	(79)
Southwest	0.9x	0.77	x	1.98	x	62.67	0.63	x	0.7	=	37.92	(79)
Southwest	0.9x	0.77	x	1.63	x	62.67	0.63	x	0.7	=	31.22	(79)
Southwest	0.9x	0.77	x	2.04	x	62.67	0.63	x	0.7	=	39.07	(79)
Southwest	0.9x	0.77	x	0.93	x	85.75	0.63	x	0.7	=	24.37	(79)
Southwest	0.9x	0.77	x	1.98	x	85.75	0.63	x	0.7	=	51.89	(79)
Southwest	0.9x	0.77	x	1.63	x	85.75	0.63	x	0.7	=	42.72	(79)
Southwest	0.9x	0.77	x	2.04	x	85.75	0.63	x	0.7	=	53.46	(79)
Southwest	0.9x	0.77	x	0.93	x	106.25	0.63	x	0.7	=	30.2	(79)
Southwest	0.9x	0.77	x	1.98	x	106.25	0.63	x	0.7	=	64.29	(79)
Southwest	0.9x	0.77	x	1.63	x	106.25	0.63	x	0.7	=	52.93	(79)
Southwest	0.9x	0.77	x	2.04	x	106.25	0.63	x	0.7	=	66.24	(79)
Southwest	0.9x	0.77	x	0.93	x	119.01	0.63	x	0.7	=	33.83	(79)
Southwest	0.9x	0.77	x	1.98	x	119.01	0.63	x	0.7	=	72.01	(79)
Southwest	0.9x	0.77	x	1.63	x	119.01	0.63	x	0.7	=	59.29	(79)
Southwest	0.9x	0.77	x	2.04	x	119.01	0.63	x	0.7	=	74.2	(79)
Southwest	0.9x	0.77	x	0.93	x	118.15	0.63	x	0.7	=	33.58	(79)
Southwest	0.9x	0.77	x	1.98	x	118.15	0.63	x	0.7	=	71.49	(79)
Southwest	0.9x	0.77	x	1.63	x	118.15	0.63	x	0.7	=	58.86	(79)
Southwest	0.9x	0.77	x	2.04	x	118.15	0.63	x	0.7	=	73.66	(79)
Southwest	0.9x	0.77	x	0.93	x	113.91	0.63	x	0.7	=	32.38	(79)
Southwest	0.9x	0.77	x	1.98	x	113.91	0.63	x	0.7	=	68.93	(79)
Southwest	0.9x	0.77	x	1.63	x	113.91	0.63	x	0.7	=	56.74	(79)
Southwest	0.9x	0.77	x	2.04	x	113.91	0.63	x	0.7	=	71.02	(79)
Southwest	0.9x	0.77	x	0.93	x	104.39	0.63	x	0.7	=	29.67	(79)
Southwest	0.9x	0.77	x	1.98	x	104.39	0.63	x	0.7	=	63.17	(79)
Southwest	0.9x	0.77	x	1.63	x	104.39	0.63	x	0.7	=	52	(79)
Southwest	0.9x	0.77	x	2.04	x	104.39	0.63	x	0.7	=	65.08	(79)
Southwest	0.9x	0.77	x	0.93	x	92.85	0.63	x	0.7	=	26.39	(79)
Southwest	0.9x	0.77	x	1.98	x	92.85	0.63	x	0.7	=	56.19	(79)
Southwest	0.9x	0.77	x	1.63	x	92.85	0.63	x	0.7	=	46.25	(79)
Southwest	0.9x	0.77	x	2.04	x	92.85	0.63	x	0.7	=	57.89	(79)
Southwest	0.9x	0.77	x	0.93	x	69.27	0.63	x	0.7	=	19.69	(79)
Southwest	0.9x	0.77	x	1.98	x	69.27	0.63	x	0.7	=	41.91	(79)
Southwest	0.9x	0.77	x	1.63	x	69.27	0.63	x	0.7	=	34.51	(79)
Southwest	0.9x	0.77	x	2.04	x	69.27	0.63	x	0.7	=	43.18	(79)
Southwest	0.9x	0.77	x	0.93	x	44.07	0.63	x	0.7	=	12.53	(79)
Southwest	0.9x	0.77	x	1.98	x	44.07	0.63	x	0.7	=	26.67	(79)
Southwest	0.9x	0.77	x	1.63	x	44.07	0.63	x	0.7	=	21.95	(79)
Southwest	0.9x	0.77	x	2.04	x	44.07	0.63	x	0.7	=	27.48	(79)

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Southwest	0.9x	0.77	x	0.93	x	31.49		0.63	x	0.7	=	8.95	(79)
Southwest	0.9x	0.77	x	1.98	x	31.49		0.63	x	0.7	=	19.05	(79)
Southwest	0.9x	0.77	x	1.63	x	31.49		0.63	x	0.7	=	15.69	(79)
Southwest	0.9x	0.77	x	2.04	x	31.49		0.63	x	0.7	=	19.63	(79)
Rooflights	0.9x	1	x	0.77	x	26	x	0.63	x	0.7	=	7.95	(82)
Rooflights	0.9x	1	x	0.77	x	54	x	0.63	x	0.7	=	16.52	(82)
Rooflights	0.9x	1	x	0.77	x	96	x	0.63	x	0.7	=	29.36	(82)
Rooflights	0.9x	1	x	0.77	x	150	x	0.63	x	0.7	=	45.88	(82)
Rooflights	0.9x	1	x	0.77	x	192	x	0.63	x	0.7	=	58.72	(82)
Rooflights	0.9x	1	x	0.77	x	200	x	0.63	x	0.7	=	61.17	(82)
Rooflights	0.9x	1	x	0.77	x	189	x	0.63	x	0.7	=	57.8	(82)
Rooflights	0.9x	1	x	0.77	x	157	x	0.63	x	0.7	=	48.02	(82)
Rooflights	0.9x	1	x	0.77	x	115	x	0.63	x	0.7	=	35.17	(82)
Rooflights	0.9x	1	x	0.77	x	66	x	0.63	x	0.7	=	20.19	(82)
Rooflights	0.9x	1	x	0.77	x	33	x	0.63	x	0.7	=	10.09	(82)
Rooflights	0.9x	1	x	0.77	x	21	x	0.63	x	0.7	=	6.42	(82)

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

(83)m=	137.62	244.9	361.81	491.25	588.11	600.16	571.86	497.34	406.4	277.98	166.78	116.51	(83)

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

(84)m=	510.41	615.07	718.44	826.41	901.52	892.52	850.91	782.8	703.15	596.4	510.02	478.49	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.82	0.65	0.49	0.55	0.8	0.96	0.99	1	(86)

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

(87)m=	19.6	19.8	20.11	20.5	20.8	20.95	20.99	20.98	20.87	20.46	19.96	19.57	(87)

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

(88)m=	19.82	19.82	19.83	19.84	19.84	19.85	19.85	19.86	19.85	19.84	19.84	19.83	(88)

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

(89)m=	1	0.99	0.97	0.91	0.77	0.55	0.37	0.42	0.72	0.94	0.99	1	(89)

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

(90)m=	17.98	18.27	18.72	19.27	19.65	19.82	19.85	19.85	19.75	19.24	18.51	17.94	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

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

(92)m=	18.55	18.81	19.21	19.7	20.06	20.22	20.26	20.25	20.15	19.67	19.02	18.52	(92)

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

(93)m=	18.55	18.81	19.21	19.7	20.06	20.22	20.26	20.25	20.15	19.67	19.02	18.52	(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

TER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.96	0.91	0.78	0.58	0.41	0.47	0.74	0.94	0.99	1	(94)

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

(95)m=	507.15	606.16	693.03	748.22	701.68	520.71	349.76	365.25	520.75	560.66	503.42	476.16	(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=	1424.7	1386.64	1263.27	1059.63	817.9	543.77	353.38	371.6	587.5	887.43	1172.53	1415.25	(97)

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

(98)m=	682.66	524.48	424.26	224.22	86.47	0	0	0	0	243.12	481.75	698.68

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3365.65 (98)

Space heating requirement in kWh/m²/year 44.64 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(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)	682.66	524.48	424.26	224.22	86.47	0	0	0	0	243.12	481.75	698.68	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	730.9	561.55	454.24	240.06	92.58	0	0	0	0	260.3	515.8	748.05	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3603.48 (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)

	198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66

Efficiency of water heater 80.3 (216)

(217)m=	87.91	87.66	87.13	85.9	83.65	80.3	80.3	80.3	80.3	85.99	87.42	88	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	225.59	197.62	206.86	186.1	185.03	169.76	162.65	181.31	183.32	194.94	204.68	220.08

Total = Sum(219a)$_{1...12}$ = 2317.95 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3603.48
Water heating fuel used		2317.95
Electricity for pumps, fans and electric keep-hot		

central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			329.88	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	778.35	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	500.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1279.03	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	171.21	(268)
Total CO2, kg/year			sum of (265)…(271) =		1489.16	(272)

TER = 19.75 (273)

eight
associates

SAP Worksheets
Energy Statement
34A-36 Kilburn High Road

Lean DER Worksheets

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.17	(1a) x	2.7	(2a) =	135.46	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.17	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	135.46	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.14	(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
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	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) = 75.65 (23c)

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

(24a)m=	0.3	0.3	0.29	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 × (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	0.29	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	x	1.3	=	2.6			(26)
Windows Type 1			9.56	x1/[1/(1.3)+ 0.04]		=	11.81			(27)
Windows Type 2			4.62	x1/[1/(1.3)+ 0.04]		=	5.71			(27)
Windows Type 3			4.17	x1/[1/(1.3)+ 0.04]		=	5.15			(27)
Rooflights Type 1			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Rooflights Type 2			1.79	x1/[1/(1.6) + 0.04]		=	2.864			(27b)
Walls Type1	35.48	22.52	12.96	x	0.15	=	1.94			(29)
Walls Type2	30.48	2	28.48	x	0.13	=	3.8			(29)
Roof	50.17	2.84	47.33	x	0.1	=	4.73			(30)
Total area of elements, m²			116.13							(31)
Party wall			26.97	x	0	=	0			(32)
Party floor			50.17							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10845.77 (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 14.19 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 59.37 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.35	13.2	13.04	12.26	12.11	11.33	11.33	11.18	11.64	12.11	12.42	12.73	(38)

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

(39)m=	72.72	72.57	72.41	71.64	71.48	70.71	70.71	70.55	71.02	71.48	71.79	72.1	

Average = $Sum(39)_{1...12}$ /12= 71.6 (39)

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

(40)m=	1.45	1.45	1.44	1.43	1.42	1.41	1.41	1.41	1.42	1.42	1.43	1.44	

Average = $Sum(40)_{1...12}$ /12= 1.43 (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 1.7 (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 74.46 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.9	78.93	75.95	72.97	69.99	67.01	67.01	69.99	72.97	75.95	78.93	81.9

Total = $Sum(44)_{1...12}$ = 893.51 (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=	121.46	106.23	109.62	95.57	91.7	79.13	73.33	84.14	85.15	99.23	108.32	117.63

Total = $Sum(45)_{1...12}$ = 1171.53 (45)

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

(46)m=	18.22	15.93	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.64	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	41.74	36.33	38.7	35.99	35.67	33.05	34.15	35.67	35.99	38.7	38.92	41.74	(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=	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37	(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=	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37

Output from water heater (annual)$_{1...12}$ | 1618.16 | (64)

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

(65)m=	50.82	44.4	46.12	40.77	39.41	34.57	32.92	36.89	37.31	42.67	45.75	49.55	(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=	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	(66)

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

(67)m=	13.17	11.69	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.69	13.53	(67)

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

(68)m=	147.68	149.21	145.35	137.13	126.75	116.99	110.48	108.95	112.81	121.03	131.41	141.16	(68)

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

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(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=	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	(71)

Water heating gains (Table 5)

(72)m=	68.31	66.08	62	56.63	52.97	48.02	44.25	49.59	51.82	57.35	63.54	66.59	(72)

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

(73)m=	280.57	278.41	268.28	252.38	236.52	220.98	211.06	216.34	224.62	240.68	259.06	272.71	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	9.56	x	11.28	x	0.55	x	0.7	=	28.78	(75)
Northeast	0.9x	0.77	x	4.62	x	11.28	x	0.55	x	0.7	=	13.91	(75)
Northeast	0.9x	0.77	x	9.56	x	22.97	x	0.55	x	0.7	=	58.58	(75)
Northeast	0.9x	0.77	x	4.62	x	22.97	x	0.55	x	0.7	=	28.31	(75)
Northeast	0.9x	0.77	x	9.56	x	41.38	x	0.55	x	0.7	=	105.54	(75)
Northeast	0.9x	0.77	x	4.62	x	41.38	x	0.55	x	0.7	=	51.01	(75)
Northeast	0.9x	0.77	x	9.56	x	67.96	x	0.55	x	0.7	=	173.33	(75)
Northeast	0.9x	0.77	x	4.62	x	67.96	x	0.55	x	0.7	=	83.77	(75)
Northeast	0.9x	0.77	x	9.56	x	91.35	x	0.55	x	0.7	=	232.99	(75)
Northeast	0.9x	0.77	x	4.62	x	91.35	x	0.55	x	0.7	=	112.6	(75)
Northeast	0.9x	0.77	x	9.56	x	97.38	x	0.55	x	0.7	=	248.39	(75)
Northeast	0.9x	0.77	x	4.62	x	97.38	x	0.55	x	0.7	=	120.04	(75)
Northeast	0.9x	0.77	x	9.56	x	91.1	x	0.55	x	0.7	=	232.37	(75)
Northeast	0.9x	0.77	x	4.62	x	91.1	x	0.55	x	0.7	=	112.29	(75)
Northeast	0.9x	0.77	x	9.56	x	72.63	x	0.55	x	0.7	=	185.25	(75)
Northeast	0.9x	0.77	x	4.62	x	72.63	x	0.55	x	0.7	=	89.52	(75)
Northeast	0.9x	0.77	x	9.56	x	50.42	x	0.55	x	0.7	=	128.61	(75)
Northeast	0.9x	0.77	x	4.62	x	50.42	x	0.55	x	0.7	=	62.15	(75)
Northeast	0.9x	0.77	x	9.56	x	28.07	x	0.55	x	0.7	=	71.59	(75)
Northeast	0.9x	0.77	x	4.62	x	28.07	x	0.55	x	0.7	=	34.6	(75)
Northeast	0.9x	0.77	x	9.56	x	14.2	x	0.55	x	0.7	=	36.21	(75)
Northeast	0.9x	0.77	x	4.62	x	14.2	x	0.55	x	0.7	=	17.5	(75)
Northeast	0.9x	0.77	x	9.56	x	9.21	x	0.55	x	0.7	=	23.5	(75)
Northeast	0.9x	0.77	x	4.62	x	9.21	x	0.55	x	0.7	=	11.36	(75)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.55	x	0.7	=	25.11	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.55	x	0.7	=	51.1	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.55	x	0.7	=	92.07	(81)
Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.55	x	0.7	=	151.21	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.55	x	0.7	=	203.26	(81)
Northwest	0.9x	0.77	x	4.17	x	97.38	x	0.55	x	0.7	=	216.7	(81)
Northwest	0.9x	0.77	x	4.17	x	91.1	x	0.55	x	0.7	=	202.71	(81)
Northwest	0.9x	0.77	x	4.17	x	72.63	x	0.55	x	0.7	=	161.61	(81)
Northwest	0.9x	0.77	x	4.17	x	50.42	x	0.55	x	0.7	=	112.19	(81)
Northwest	0.9x	0.77	x	4.17	x	28.07	x	0.55	x	0.7	=	62.45	(81)
Northwest	0.9x	0.77	x	4.17	x	14.2	x	0.55	x	0.7	=	31.59	(81)
Northwest	0.9x	0.77	x	4.17	x	9.21	x	0.55	x	0.7	=	20.5	(81)
Rooflights	0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights	0.9x	1	x	1.79	x	26	x	0.55	x	0.8	=	18.43	(82)
Rooflights	0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)

Rooflights 0.9x	1	x	1.79	x	54	x	0.55	x	0.8	=	38.28	(82)
Rooflights 0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights 0.9x	1	x	1.79	x	96	x	0.55	x	0.8	=	68.05	(82)
Rooflights 0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights 0.9x	1	x	1.79	x	150	x	0.55	x	0.8	=	106.33	(82)
Rooflights 0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights 0.9x	1	x	1.79	x	192	x	0.55	x	0.8	=	136.1	(82)
Rooflights 0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights 0.9x	1	x	1.79	x	200	x	0.55	x	0.8	=	141.77	(82)
Rooflights 0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights 0.9x	1	x	1.79	x	189	x	0.55	x	0.8	=	133.97	(82)
Rooflights 0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights 0.9x	1	x	1.79	x	157	x	0.55	x	0.8	=	111.29	(82)
Rooflights 0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights 0.9x	1	x	1.79	x	115	x	0.55	x	0.8	=	81.52	(82)
Rooflights 0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights 0.9x	1	x	1.79	x	66	x	0.55	x	0.8	=	46.78	(82)
Rooflights 0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights 0.9x	1	x	1.79	x	33	x	0.55	x	0.8	=	23.39	(82)
Rooflights 0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)
Rooflights 0.9x	1	x	1.79	x	21	x	0.55	x	0.8	=	14.89	(82)

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

(83)m=	97.03	198.73	356.59	577.01	764.78	810.06	759.93	612.94	432.28	242.87	122.41	78.98	(83)

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

(84)m=	377.61	477.13	624.87	829.39	1001.3	1031.04	970.99	829.29	656.9	483.55	381.48	351.69	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.95	0.83	0.62	0.43	0.32	0.39	0.68	0.94	0.99	1	(86)

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

(87)m=	19.51	19.76	20.19	20.68	20.92	20.99	21	20.99	20.92	20.48	19.9	19.47	(87)

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

(88)m=	19.73	19.73	19.73	19.74	19.74	19.76	19.76	19.76	19.75	19.74	19.74	19.73	(88)

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

(89)m=	0.99	0.98	0.94	0.78	0.55	0.35	0.23	0.28	0.58	0.91	0.99	0.99	(89)

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

(90)m=	17.78	18.15	18.76	19.41	19.68	19.75	19.76	19.76	19.7	19.19	18.35	17.73	(90)

fLA = Living area ÷ (4) = | 0.47 | (91)

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

(92)m=	18.6	18.91	19.44	20.01	20.27	20.33	20.34	20.34	20.28	19.8	19.08	18.55	(92)

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

(93)m=	18.45	18.76	19.29	19.86	20.12	20.18	20.19	20.19	20.13	19.65	18.93	18.4	(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	0.93	0.79	0.57	0.38	0.26	0.32	0.61	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	374.02	465.96	580.26	652.19	572.06	390.84	253.43	266.1	401.2	438.26	374.29	349.15	(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=	1029.09	1005.8	925.83	785	601.68	394.85	254.03	267.51	427.91	646.84	849.47	1023.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	487.37	362.77	257.1	95.62	22.04	0	0	0	0	155.18	342.13	502.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2224.27 (98)

Space heating requirement in kWh/m²/year 44.33 (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		90.3	(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)													
	487.37	362.77	257.1	95.62	22.04	0	0	0	0	155.18	342.13	502.05	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	539.72	401.74	284.72	105.89	24.4	0	0	0	0	171.85	378.89	555.98	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2463.2 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	163.2	142.56	148.32	131.56	127.37	112.18	107.48	119.81	121.13	137.94	147.24	159.37	
Efficiency of water heater												81	(216)
(217)m=	87.77	87.47	86.66	84.67	82.25	81	81	81	81	85.67	87.28	87.87	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	185.94	162.99	171.16	155.37	154.86	138.49	132.69	147.92	149.55	161.01	168.69	181.37	

Total = Sum(219a)$_{1...12}$ = 1910.02 (219)

DER WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2463.2	
Water heating fuel used			1910.02	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		109.48		(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) =		184.48	(231)
Electricity for lighting			232.5	(232)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	532.05	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	412.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =				944.62	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	95.75	(267)
Electricity for lighting	(232)	x	0.519	=	120.67	(268)
Total CO2, kg/year			sum of (265)…(271) =		1161.03	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		23.14	(273)
EI rating (section 14)					84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.25	(1a)	x	2.7	(2a)	=	159.98	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			159.98	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.12	(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
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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

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) = 75.65 (23c)

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

(24a)m=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	1.3	=	2.6			(26)
Windows Type 1			8.26	x1/[1/(1.3)+ 0.04]		=	10.21			(27)
Windows Type 2			4.21	x1/[1/(1.3)+ 0.04]		=	5.2			(27)
Windows Type 3			3.21	x1/[1/(1.3)+ 0.04]		=	3.97			(27)
Windows Type 4			4.37	x1/[1/(1.3)+ 0.04]		=	5.4			(27)
Rooflights			1.61	x1/[1/(1.6) + 0.04]		=	2.576			(27b)
Walls Type1	38.95	20.05	18.9	x	0.15	=	2.84			(29)
Walls Type2	45.47	2	43.47	x	0.13	=	5.81			(29)
Roof	59.25	1.61	57.64	x	0.1	=	5.76			(30)
Total area of elements, m²			143.67							(31)
Party wall			25.95	x	0	=	0			(32)
Party floor			59.25							(32a)

** 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) = 44.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15258.06 (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 14.56 (36)

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

DER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	58.77	(37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.25	14.1	13.95	13.18	13.02	12.26	12.26	12.1	12.56	13.02	13.33	13.64	(38)

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

(39)m=	73.02	72.86	72.71	71.94	71.79	71.02	71.02	70.87	71.33	71.79	72.1	72.4	

Average = Sum(39)$_{1...12}$ /12= 71.91 (39)

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

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22	

Average = Sum(40)$_{1...12}$ /12= 1.21 (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 1.96 (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 80.76 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	88.83	85.6	82.37	79.14	75.91	72.68	72.68	75.91	79.14	82.37	85.6	88.83	

Total = Sum(44)$_{1...12}$ = 969.1 (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=	131.74	115.22	118.9	103.66	99.46	85.83	79.53	91.26	92.35	107.63	117.49	127.58	

Total = Sum(45)$_{1...12}$ = 1270.64 (45)

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

(46)m=	19.76	17.28	17.83	15.55	14.92	12.87	11.93	13.69	13.85	16.14	17.62	19.14	(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	45.27	39.4	41.98	39.03	38.68	35.84	37.04	38.68	39.03	41.98	42.22	45.27	(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=	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85	(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=	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85

Output from water heater (annual)$_{1...12}$ — 1755.06 (64)

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

(65)m=	55.12	48.16	50.03	44.22	42.74	37.5	35.7	40.02	40.46	46.28	49.62	53.74	(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=	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	(66)

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

(67)m=	15.25	13.54	11.02	8.34	6.23	5.26	5.69	7.39	9.92	12.6	14.7	15.67	(67)

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

(68)m=	171.05	172.83	168.35	158.83	146.81	135.51	127.97	126.19	130.66	140.19	152.21	163.5	(68)

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

(69)m=	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	(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=	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	(71)

Water heating gains (Table 5)

(72)m=	74.09	71.67	67.24	61.42	57.45	52.08	47.99	53.79	56.2	62.21	68.91	72.23	(72)

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

(73)m=	315.79	313.44	302.01	284	265.9	248.26	237.05	242.77	252.19	270.39	291.23	306.81	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	4.21	x	11.28	x	0.55	x	0.7	=	12.67	(75)
Northeast	0.9x	0.77	x	4.21	x	22.97	x	0.55	x	0.7	=	25.8	(75)
Northeast	0.9x	0.77	x	4.21	x	41.38	x	0.55	x	0.7	=	46.48	(75)
Northeast	0.9x	0.77	x	4.21	x	67.96	x	0.55	x	0.7	=	76.33	(75)
Northeast	0.9x	0.77	x	4.21	x	91.35	x	0.55	x	0.7	=	102.6	(75)
Northeast	0.9x	0.77	x	4.21	x	97.38	x	0.55	x	0.7	=	109.39	(75)
Northeast	0.9x	0.77	x	4.21	x	91.1	x	0.55	x	0.7	=	102.33	(75)
Northeast	0.9x	0.77	x	4.21	x	72.63	x	0.55	x	0.7	=	81.58	(75)
Northeast	0.9x	0.77	x	4.21	x	50.42	x	0.55	x	0.7	=	56.63	(75)
Northeast	0.9x	0.77	x	4.21	x	28.07	x	0.55	x	0.7	=	31.53	(75)
Northeast	0.9x	0.77	x	4.21	x	14.2	x	0.55	x	0.7	=	15.95	(75)
Northeast	0.9x	0.77	x	4.21	x	9.21	x	0.55	x	0.7	=	10.35	(75)
Northwest	0.9x	0.77	x	8.26	x	11.28	x	0.55	x	0.7	=	24.87	(81)
Northwest	0.9x	0.77	x	3.21	x	11.28	x	0.55	x	0.7	=	9.66	(81)
Northwest	0.9x	0.77	x	4.37	x	11.28	x	0.55	x	0.7	=	13.16	(81)
Northwest	0.9x	0.77	x	8.26	x	22.97	x	0.55	x	0.7	=	50.61	(81)
Northwest	0.9x	0.77	x	3.21	x	22.97	x	0.55	x	0.7	=	19.67	(81)
Northwest	0.9x	0.77	x	4.37	x	22.97	x	0.55	x	0.7	=	26.78	(81)
Northwest	0.9x	0.77	x	8.26	x	41.38	x	0.55	x	0.7	=	91.19	(81)
Northwest	0.9x	0.77	x	3.21	x	41.38	x	0.55	x	0.7	=	35.44	(81)
Northwest	0.9x	0.77	x	4.37	x	41.38	x	0.55	x	0.7	=	48.25	(81)
Northwest	0.9x	0.77	x	8.26	x	67.96	x	0.55	x	0.7	=	149.76	(81)
Northwest	0.9x	0.77	x	3.21	x	67.96	x	0.55	x	0.7	=	58.2	(81)
Northwest	0.9x	0.77	x	4.37	x	67.96	x	0.55	x	0.7	=	79.23	(81)
Northwest	0.9x	0.77	x	8.26	x	91.35	x	0.55	x	0.7	=	201.31	(81)
Northwest	0.9x	0.77	x	3.21	x	91.35	x	0.55	x	0.7	=	78.23	(81)
Northwest	0.9x	0.77	x	4.37	x	91.35	x	0.55	x	0.7	=	106.5	(81)
Northwest	0.9x	0.77	x	8.26	x	97.38	x	0.55	x	0.7	=	214.62	(81)
Northwest	0.9x	0.77	x	3.21	x	97.38	x	0.55	x	0.7	=	83.4	(81)
Northwest	0.9x	0.77	x	4.37	x	97.38	x	0.55	x	0.7	=	113.54	(81)
Northwest	0.9x	0.77	x	8.26	x	91.1	x	0.55	x	0.7	=	200.77	(81)
Northwest	0.9x	0.77	x	3.21	x	91.1	x	0.55	x	0.7	=	78.02	(81)
Northwest	0.9x	0.77	x	4.37	x	91.1	x	0.55	x	0.7	=	106.22	(81)
Northwest	0.9x	0.77	x	8.26	x	72.63	x	0.55	x	0.7	=	160.06	(81)
Northwest	0.9x	0.77	x	3.21	x	72.63	x	0.55	x	0.7	=	62.2	(81)
Northwest	0.9x	0.77	x	4.37	x	72.63	x	0.55	x	0.7	=	84.68	(81)
Northwest	0.9x	0.77	x	8.26	x	50.42	x	0.55	x	0.7	=	111.12	(81)
Northwest	0.9x	0.77	x	3.21	x	50.42	x	0.55	x	0.7	=	43.18	(81)
Northwest	0.9x	0.77	x	4.37	x	50.42	x	0.55	x	0.7	=	58.79	(81)

Northwest	0.9x	0.77	x	8.26	x	28.07	x	0.55	x	0.7	=	61.85	(81)
Northwest	0.9x	0.77	x	3.21	x	28.07	x	0.55	x	0.7	=	24.04	(81)
Northwest	0.9x	0.77	x	4.37	x	28.07	x	0.55	x	0.7	=	32.72	(81)
Northwest	0.9x	0.77	x	8.26	x	14.2	x	0.55	x	0.7	=	31.29	(81)
Northwest	0.9x	0.77	x	3.21	x	14.2	x	0.55	x	0.7	=	12.16	(81)
Northwest	0.9x	0.77	x	4.37	x	14.2	x	0.55	x	0.7	=	16.55	(81)
Northwest	0.9x	0.77	x	8.26	x	9.21	x	0.55	x	0.7	=	20.31	(81)
Northwest	0.9x	0.77	x	3.21	x	9.21	x	0.55	x	0.7	=	7.89	(81)
Northwest	0.9x	0.77	x	4.37	x	9.21	x	0.55	x	0.7	=	10.74	(81)
Rooflights	0.9x	1	x	1.61	x	26	x	0.55	x	0.8	=	16.58	(82)
Rooflights	0.9x	1	x	1.61	x	54	x	0.55	x	0.8	=	34.43	(82)
Rooflights	0.9x	1	x	1.61	x	96	x	0.55	x	0.8	=	61.21	(82)
Rooflights	0.9x	1	x	1.61	x	150	x	0.55	x	0.8	=	95.63	(82)
Rooflights	0.9x	1	x	1.61	x	192	x	0.55	x	0.8	=	122.41	(82)
Rooflights	0.9x	1	x	1.61	x	200	x	0.55	x	0.8	=	127.51	(82)
Rooflights	0.9x	1	x	1.61	x	189	x	0.55	x	0.8	=	120.5	(82)
Rooflights	0.9x	1	x	1.61	x	157	x	0.55	x	0.8	=	100.1	(82)
Rooflights	0.9x	1	x	1.61	x	115	x	0.55	x	0.8	=	73.32	(82)
Rooflights	0.9x	1	x	1.61	x	66	x	0.55	x	0.8	=	42.08	(82)
Rooflights	0.9x	1	x	1.61	x	33	x	0.55	x	0.8	=	21.04	(82)
Rooflights	0.9x	1	x	1.61	x	21	x	0.55	x	0.8	=	13.39	(82)

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

(83)m=	76.93	157.29	282.56	459.16	611.06	648.46	607.84	488.61	343.04	192.22	96.98	62.68	(83)

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

(84)m=	392.73	470.73	584.57	743.16	876.96	896.73	844.89	731.38	595.23	462.62	388.21	369.49	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.89	0.7	0.5	0.37	0.44	0.74	0.96	0.99	1	(86)

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

(87)m=	19.71	19.9	20.24	20.67	20.92	20.99	21	20.99	20.92	20.53	20.03	19.67	(87)

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

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(88)

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

(89)m=	1	0.99	0.96	0.85	0.64	0.42	0.28	0.34	0.66	0.94	0.99	1	(89)

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

(90)m=	18.18	18.46	18.96	19.55	19.84	19.91	19.92	19.92	19.86	19.38	18.67	18.14	(90)

fLA = Living area ÷ (4) = 0.47 (91)

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

(92)m=	18.9	19.13	19.56	20.07	20.34	20.42	20.42	20.42	20.36	19.91	19.31	18.86	(92)

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

(93)m=	18.75	18.98	19.41	19.92	20.19	20.27	20.27	20.27	20.21	19.76	19.16	18.71	(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	0.85	0.65	0.44	0.31	0.37	0.68	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	390.48	464.44	559.95	634.38	573.03	397.82	260.34	273.02	404.87	433.75	383.71	367.88	(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=	1054.84	1026.14	938.49	792.88	609.64	402.37	260.93	274.47	435.52	657.83	869.4	1050.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	494.29	377.46	281.63	114.12	27.24	0	0	0	0	166.72	349.7	507.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2318.96 (98)

Space heating requirement in kWh/m²/year 39.14 (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		90.3	(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)														
	494.29	377.46	281.63	114.12	27.24	0	0	0	0	166.72	349.7	507.81		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	547.38	418.01	311.89	126.38	30.17	0	0	0	0	184.62	387.26	562.36		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2568.06	(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)														
	177.01	154.62	160.87	142.69	138.15	121.67	116.57	129.95	131.38	149.61	159.7	172.85		
Efficiency of water heater													81	(216)
(217)m=	87.65	87.38	86.68	84.88	82.4	81	81	81	81	85.65	87.16	87.74		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	201.96	176.94	185.59	168.09	167.66	150.21	143.91	160.43	162.2	174.67	183.22	197		
Total = Sum(219a)$_{1...12}$ =													2071.89	(219)

DER WorkSheet: New dwelling design stage

Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2568.06	
Water heating fuel used			2071.89	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		129.3		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		204.3	(231)
Electricity for lighting			269.31	(232)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	554.7	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	447.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1002.23	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	106.03	(267)
Electricity for lighting	(232) x	0.519	=	139.77	(268)
Total CO2, kg/year		sum of (265)…(271) =		1248.03	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		21.06	(273)
EI rating (section 14)				84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	72.85	(1a)	x	2.7	(2a)	=	196.69	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.85	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	196.69	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.12	(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
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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

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) =	75.65	(23c)

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

(24a)m=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	1.3	=	2.6			(26)
Windows Type 1			7.1	x1/[1/(1.3)+ 0.04]		=	8.77			(27)
Windows Type 2			9.86	x1/[1/(1.3)+ 0.04]		=	12.18			(27)
Windows Type 3			7.48	x1/[1/(1.3)+ 0.04]		=	9.24			(27)
Windows Type 4			1.53	x1/[1/(1.3)+ 0.04]		=	1.89			(27)
Rooflights			1.14	x1/[1/(1.6) + 0.04]		=	1.824			(27b)
Walls Type1	40.58	25.97	14.61	x	0.15	=	2.19			(29)
Walls Type2	56.98	2	54.98	x	0.13	=	7.34			(29)
Roof	72.85	1.14	71.71	x	0.1	=	7.17			(30)
Total area of elements, m²			170.41							(31)
Party wall			23.2	x	0	=	0			(32)
Party floor			72.85							(32a)

** 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) =	53.11	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17245.49	(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	16.31	(36)

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

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Total fabric heat loss	(33) + (36) =	69.42	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	17.52	17.33	17.15	16.2	16.01	15.07	15.07	14.88	15.45	16.01	16.39	16.77		(38)
Heat transfer coefficient, W/K									(39)m = (37) + (38)m					
(39)m=	86.94	86.76	86.57	85.62	85.43	84.49	84.49	84.3	84.87	85.43	85.81	86.19		
										Average = Sum(39)$_{1…12}$ /12=			85.58	(39)
Heat loss parameter (HLP), W/m²K									(40)m = (39)m ÷ (4)					
(40)m=	1.19	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.16	1.17	1.18	1.18		
										Average = Sum(40)$_{1…12}$ /12=			1.17	(40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.31 (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 89.14 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 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=	98.05	94.49	90.92	87.36	83.79	80.23	80.23	83.79	87.36	90.92	94.49	98.05		
										Total = Sum(44)$_{1…12}$ =			1069.69	(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=	145.41	127.18	131.24	114.42	109.78	94.74	87.79	100.74	101.94	118.8	129.68	140.82		
										Total = Sum(45)$_{1…12}$ =			1402.53	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	21.81	19.08	19.69	17.16	16.47	14.21	13.17	15.11	15.29	17.82	19.45	21.12		(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) × (41)m

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

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

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

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

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

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

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

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

(61)m=	49.97	43.49	46.33	43.08	42.7	39.56	40.88	42.7	43.08	46.33	46.6	49.97	(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=	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79

Output from water heater (annual)$_{1...12}$ — 1937.22 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	60.84	53.16	55.22	48.81	47.18	41.39	39.41	44.17	44.66	51.08	54.77	59.32	(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=	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.17	16.14	13.13	9.94	7.43	6.27	6.78	8.81	11.82	15.01	17.52	18.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	203.86	205.97	200.64	189.29	174.97	161.5	152.51	150.39	155.72	167.07	181.4	194.86	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	(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=	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	(71)

Water heating gains (Table 5)

(72)m=	81.78	79.11	74.22	67.8	63.41	57.49	52.97	59.37	62.03	68.66	76.07	79.73	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	364.5	361.92	348.69	327.73	306.51	285.96	272.95	279.27	290.28	311.45	335.68	353.96	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.53	x	11.28	x	0.55	x	0.7	=	4.61	(75)
Northeast	0.9x	0.77	x	1.53	x	22.97	x	0.55	x	0.7	=	9.38	(75)
Northeast	0.9x	0.77	x	1.53	x	41.38	x	0.55	x	0.7	=	16.89	(75)
Northeast	0.9x	0.77	x	1.53	x	67.96	x	0.55	x	0.7	=	27.74	(75)
Northeast	0.9x	0.77	x	1.53	x	91.35	x	0.55	x	0.7	=	37.29	(75)
Northeast	0.9x	0.77	x	1.53	x	97.38	x	0.55	x	0.7	=	39.75	(75)
Northeast	0.9x	0.77	x	1.53	x	91.1	x	0.55	x	0.7	=	37.19	(75)
Northeast	0.9x	0.77	x	1.53	x	72.63	x	0.55	x	0.7	=	29.65	(75)
Northeast	0.9x	0.77	x	1.53	x	50.42	x	0.55	x	0.7	=	20.58	(75)
Northeast	0.9x	0.77	x	1.53	x	28.07	x	0.55	x	0.7	=	11.46	(75)
Northeast	0.9x	0.77	x	1.53	x	14.2	x	0.55	x	0.7	=	5.8	(75)
Northeast	0.9x	0.77	x	1.53	x	9.21	x	0.55	x	0.7	=	3.76	(75)
Southeast	0.9x	0.77	x	7.1	x	36.79	x	0.55	x	0.7	=	69.7	(77)
Southeast	0.9x	0.77	x	9.86	x	36.79	x	0.55	x	0.7	=	96.79	(77)
Southeast	0.9x	0.77	x	7.48	x	36.79	x	0.55	x	0.7	=	73.43	(77)
Southeast	0.9x	0.77	x	7.1	x	62.67	x	0.55	x	0.7	=	118.72	(77)
Southeast	0.9x	0.77	x	9.86	x	62.67	x	0.55	x	0.7	=	164.87	(77)
Southeast	0.9x	0.77	x	7.48	x	62.67	x	0.55	x	0.7	=	125.08	(77)
Southeast	0.9x	0.77	x	7.1	x	85.75	x	0.55	x	0.7	=	162.44	(77)
Southeast	0.9x	0.77	x	9.86	x	85.75	x	0.55	x	0.7	=	225.59	(77)
Southeast	0.9x	0.77	x	7.48	x	85.75	x	0.55	x	0.7	=	171.14	(77)
Southeast	0.9x	0.77	x	7.1	x	106.25	x	0.55	x	0.7	=	201.27	(77)
Southeast	0.9x	0.77	x	9.86	x	106.25	x	0.55	x	0.7	=	279.52	(77)
Southeast	0.9x	0.77	x	7.48	x	106.25	x	0.55	x	0.7	=	212.05	(77)
Southeast	0.9x	0.77	x	7.1	x	119.01	x	0.55	x	0.7	=	225.44	(77)
Southeast	0.9x	0.77	x	9.86	x	119.01	x	0.55	x	0.7	=	313.08	(77)
Southeast	0.9x	0.77	x	7.48	x	119.01	x	0.55	x	0.7	=	237.51	(77)
Southeast	0.9x	0.77	x	7.1	x	118.15	x	0.55	x	0.7	=	223.81	(77)
Southeast	0.9x	0.77	x	9.86	x	118.15	x	0.55	x	0.7	=	310.82	(77)
Southeast	0.9x	0.77	x	7.48	x	118.15	x	0.55	x	0.7	=	235.79	(77)
Southeast	0.9x	0.77	x	7.1	x	113.91	x	0.55	x	0.7	=	215.78	(77)
Southeast	0.9x	0.77	x	9.86	x	113.91	x	0.55	x	0.7	=	299.66	(77)
Southeast	0.9x	0.77	x	7.48	x	113.91	x	0.55	x	0.7	=	227.33	(77)
Southeast	0.9x	0.77	x	7.1	x	104.39	x	0.55	x	0.7	=	197.75	(77)
Southeast	0.9x	0.77	x	9.86	x	104.39	x	0.55	x	0.7	=	274.62	(77)
Southeast	0.9x	0.77	x	7.48	x	104.39	x	0.55	x	0.7	=	208.33	(77)
Southeast	0.9x	0.77	x	7.1	x	92.85	x	0.55	x	0.7	=	175.89	(77)
Southeast	0.9x	0.77	x	9.86	x	92.85	x	0.55	x	0.7	=	244.27	(77)
Southeast	0.9x	0.77	x	7.48	x	92.85	x	0.55	x	0.7	=	185.3	(77)

Southeast	0.9x	0.77	x	7.1	x	69.27	x	0.55	x	0.7	=	131.21	(77)
Southeast	0.9x	0.77	x	9.86	x	69.27	x	0.55	x	0.7	=	182.22	(77)
Southeast	0.9x	0.77	x	7.48	x	69.27	x	0.55	x	0.7	=	138.24	(77)
Southeast	0.9x	0.77	x	7.1	x	44.07	x	0.55	x	0.7	=	83.48	(77)
Southeast	0.9x	0.77	x	9.86	x	44.07	x	0.55	x	0.7	=	115.94	(77)
Southeast	0.9x	0.77	x	7.48	x	44.07	x	0.55	x	0.7	=	87.95	(77)
Southeast	0.9x	0.77	x	7.1	x	31.49	x	0.55	x	0.7	=	59.65	(77)
Southeast	0.9x	0.77	x	9.86	x	31.49	x	0.55	x	0.7	=	82.83	(77)
Southeast	0.9x	0.77	x	7.48	x	31.49	x	0.55	x	0.7	=	62.84	(77)
Rooflights	0.9x	1	x	1.14	x	26	x	0.55	x	0.8	=	11.74	(82)
Rooflights	0.9x	1	x	1.14	x	54	x	0.55	x	0.8	=	24.38	(82)
Rooflights	0.9x	1	x	1.14	x	96	x	0.55	x	0.8	=	43.34	(82)
Rooflights	0.9x	1	x	1.14	x	150	x	0.55	x	0.8	=	67.72	(82)
Rooflights	0.9x	1	x	1.14	x	192	x	0.55	x	0.8	=	86.68	(82)
Rooflights	0.9x	1	x	1.14	x	200	x	0.55	x	0.8	=	90.29	(82)
Rooflights	0.9x	1	x	1.14	x	189	x	0.55	x	0.8	=	85.32	(82)
Rooflights	0.9x	1	x	1.14	x	157	x	0.55	x	0.8	=	70.88	(82)
Rooflights	0.9x	1	x	1.14	x	115	x	0.55	x	0.8	=	51.92	(82)
Rooflights	0.9x	1	x	1.14	x	66	x	0.55	x	0.8	=	29.8	(82)
Rooflights	0.9x	1	x	1.14	x	33	x	0.55	x	0.8	=	14.9	(82)
Rooflights	0.9x	1	x	1.14	x	21	x	0.55	x	0.8	=	9.48	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	256.27	442.43	619.4	788.29	900	900.46	865.28	781.22	677.96	492.93	308.06	218.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	620.77	804.35	968.08	1116.02	1206.51	1186.42	1138.23	1060.49	968.24	804.37	643.75	572.53	(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	0.92	0.8	0.63	0.45	0.33	0.36	0.58	0.87	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.93	20.21	20.53	20.82	20.95	20.99	21	21	20.97	20.76	20.28	19.87	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.9	0.76	0.57	0.38	0.25	0.28	0.5	0.83	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.53	18.93	19.38	19.75	19.9	19.95	19.95	19.95	19.93	19.69	19.04	18.45	(90)

fLA = Living area ÷ (4) = 0.45 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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(92)m=	19.16	19.51	19.89	20.23	20.37	20.42	20.42	20.42	20.4	20.17	19.59	19.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.01	19.36	19.74	20.08	20.22	20.27	20.27	20.27	20.25	20.02	19.44	18.94	(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=	0.98	0.96	0.89	0.76	0.58	0.4	0.27	0.31	0.53	0.83	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	611.23	768.84	863.79	850.35	703.1	475.59	309.77	325.71	510.39	669.32	620.88	566.21	(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=	1278.59	1254.08	1146.44	956.93	728.05	478.68	310.12	326.33	521.78	804.83	1059.25	1270.36	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	496.51	326.08	210.29	76.74	18.57	0	0	0	0	100.82	315.63	523.89	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2068.53 (98)

Space heating requirement in kWh/m²/year 28.39 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.3	(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)													
	496.51	326.08	210.29	76.74	18.57	0	0	0	0	100.82	315.63	523.89	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	549.85	361.11	232.88	84.98	20.56	0	0	0	0	111.65	349.53	580.17	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2290.73 (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)

	195.38	170.67	177.57	157.5	152.48	134.3	128.67	143.44	145.02	165.13	176.28	190.79	
Efficiency of water heater												81	(216)
(217)m=	87.46	86.87	85.79	83.83	81.92	81	81	81	81	84.29	86.73	87.61	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	223.38	196.46	206.98	187.88	186.15	165.8	158.85	177.08	179.04	195.91	203.24	217.76

Total = Sum(219a)$_{1...12}$ = 2298.53 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2290.73	
Water heating fuel used			2298.53	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		158.98		(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) =		233.98	(231)
Electricity for lighting			320.96	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	494.8	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	496.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =				991.28	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	121.43	(267)
Electricity for lighting	(232)	x	0.519	=	166.58	(268)
Total CO2, kg/year			sum of (265)…(271) =		1279.29	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		17.56	(273)
EI rating (section 14)					85	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.4	(1a) x	2.7	(2a) =	165.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	165.78	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.13	(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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

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) =	75.65	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	1.3	=	2.6			(26)
Windows Type 1			3.7	x1/[1/(1.3)+ 0.04]		=	4.57			(27)
Windows Type 2			0.91	x1/[1/(1.3)+ 0.04]		=	1.12			(27)
Windows Type 3			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Windows Type 4			8.37	x1/[1/(1.3)+ 0.04]		=	10.34			(27)
Windows Type 5			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Walls Type1	51.43	29.26	22.17	x	0.15	=	3.33			(29)
Walls Type2	35.95	2	33.95	x	0.13	=	4.53			(29)
Roof	61.4	0	61.4	x	0.1	=	6.14			(30)
Total area of elements, m²			148.78							(31)
Party wall			17.92	x	0	=	0			(32)
Party floor			61.4							(32a)

** 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) =	52.76	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14029.8	(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	15.8	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss	(33) + (36) =	68.55	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.55	15.38	15.21	14.33	14.16	13.29	13.29	13.11	13.64	14.16	14.51	14.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	84.11	83.93	83.76	82.89	82.71	81.84	81.84	81.67	82.19	82.71	83.06	83.41	

Average = Sum(39)$_{1...12}$ /12= 82.84 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.36	1.35	1.35	1.33	1.33	1.33	1.34	1.35	1.35	1.36	

Average = Sum(40)$_{1...12}$ /12= 1.35 (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 2.02 (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 82.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.42	87.13	83.84	80.55	77.27	73.98	73.98	77.27	80.55	83.84	87.13	90.42	

Total = Sum(44)$_{1...12}$ = 986.36 (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=	134.09	117.27	121.01	105.5	101.23	87.36	80.95	92.89	94	109.55	119.58	129.85	

Total = Sum(45)$_{1...12}$ = 1293.28 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.11	17.59	18.15	15.83	15.18	13.1	12.14	13.93	14.1	16.43	17.94	19.48	(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) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	46.08	40.1	42.72	39.72	39.37	36.48	37.7	39.37	39.72	42.72	42.97	46.08	(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=	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93	(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=	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93	

Output from water heater (annual)$_{1...12}$ — 1786.33 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	56.1	49.02	50.92	45.01	43.5	38.17	36.34	40.73	41.19	47.11	50.5	54.7	(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=	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.73	13.97	11.36	8.6	6.43	5.43	5.87	7.63	10.23	13	15.17	16.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	176.46	178.29	173.68	163.86	151.46	139.8	132.02	130.18	134.8	144.62	157.02	168.68	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	(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=	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	(71)

Water heating gains (Table 5)

(72)m=	75.41	72.94	68.44	62.52	58.47	53.01	48.84	54.74	57.2	63.31	70.14	73.52	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.92	321.53	309.8	291.29	272.67	254.55	243.04	248.87	258.55	277.25	298.65	314.68	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest	0.9x	0.77	x	8.37	x	36.79		0.55	x	0.7	=	82.17	(79)
Southwest	0.9x	0.77	x	6.29	x	36.79		0.55	x	0.7	=	61.75	(79)
Southwest	0.9x	0.77	x	8.37	x	62.67		0.55	x	0.7	=	139.96	(79)
Southwest	0.9x	0.77	x	6.29	x	62.67		0.55	x	0.7	=	105.18	(79)
Southwest	0.9x	0.77	x	8.37	x	85.75		0.55	x	0.7	=	191.5	(79)
Southwest	0.9x	0.77	x	6.29	x	85.75		0.55	x	0.7	=	143.91	(79)
Southwest	0.9x	0.77	x	8.37	x	106.25		0.55	x	0.7	=	237.28	(79)
Southwest	0.9x	0.77	x	6.29	x	106.25		0.55	x	0.7	=	178.31	(79)
Southwest	0.9x	0.77	x	8.37	x	119.01		0.55	x	0.7	=	265.77	(79)
Southwest	0.9x	0.77	x	6.29	x	119.01		0.55	x	0.7	=	199.72	(79)
Southwest	0.9x	0.77	x	8.37	x	118.15		0.55	x	0.7	=	263.85	(79)
Southwest	0.9x	0.77	x	6.29	x	118.15		0.55	x	0.7	=	198.28	(79)
Southwest	0.9x	0.77	x	8.37	x	113.91		0.55	x	0.7	=	254.38	(79)
Southwest	0.9x	0.77	x	6.29	x	113.91		0.55	x	0.7	=	191.16	(79)
Southwest	0.9x	0.77	x	8.37	x	104.39		0.55	x	0.7	=	233.12	(79)
Southwest	0.9x	0.77	x	6.29	x	104.39		0.55	x	0.7	=	175.19	(79)
Southwest	0.9x	0.77	x	8.37	x	92.85		0.55	x	0.7	=	207.35	(79)
Southwest	0.9x	0.77	x	6.29	x	92.85		0.55	x	0.7	=	155.82	(79)
Southwest	0.9x	0.77	x	8.37	x	69.27		0.55	x	0.7	=	154.69	(79)
Southwest	0.9x	0.77	x	6.29	x	69.27		0.55	x	0.7	=	116.25	(79)
Southwest	0.9x	0.77	x	8.37	x	44.07		0.55	x	0.7	=	98.42	(79)
Southwest	0.9x	0.77	x	6.29	x	44.07		0.55	x	0.7	=	73.96	(79)
Southwest	0.9x	0.77	x	8.37	x	31.49		0.55	x	0.7	=	70.32	(79)
Southwest	0.9x	0.77	x	6.29	x	31.49		0.55	x	0.7	=	52.84	(79)
Northwest	0.9x	0.77	x	3.7	x	11.28	x	0.55	x	0.7	=	22.28	(81)
Northwest	0.9x	0.77	x	0.91	x	11.28	x	0.55	x	0.7	=	2.74	(81)
Northwest	0.9x	0.77	x	6.29	x	11.28	x	0.55	x	0.7	=	18.94	(81)
Northwest	0.9x	0.77	x	3.7	x	22.97	x	0.55	x	0.7	=	45.34	(81)
Northwest	0.9x	0.77	x	0.91	x	22.97	x	0.55	x	0.7	=	5.58	(81)
Northwest	0.9x	0.77	x	6.29	x	22.97	x	0.55	x	0.7	=	38.54	(81)
Northwest	0.9x	0.77	x	3.7	x	41.38	x	0.55	x	0.7	=	81.7	(81)
Northwest	0.9x	0.77	x	0.91	x	41.38	x	0.55	x	0.7	=	10.05	(81)
Northwest	0.9x	0.77	x	6.29	x	41.38	x	0.55	x	0.7	=	69.44	(81)
Northwest	0.9x	0.77	x	3.7	x	67.96	x	0.55	x	0.7	=	134.17	(81)
Northwest	0.9x	0.77	x	0.91	x	67.96	x	0.55	x	0.7	=	16.5	(81)
Northwest	0.9x	0.77	x	6.29	x	67.96	x	0.55	x	0.7	=	114.04	(81)
Northwest	0.9x	0.77	x	3.7	x	91.35	x	0.55	x	0.7	=	180.35	(81)
Northwest	0.9x	0.77	x	0.91	x	91.35	x	0.55	x	0.7	=	22.18	(81)
Northwest	0.9x	0.77	x	6.29	x	91.35	x	0.55	x	0.7	=	153.3	(81)

Northwest 0.9x	0.77	x	3.7	x	97.38	x	0.55	x	0.7	=	192.27	(81)
Northwest 0.9x	0.77	x	0.91	x	97.38	x	0.55	x	0.7	=	23.64	(81)
Northwest 0.9x	0.77	x	6.29	x	97.38	x	0.55	x	0.7	=	163.43	(81)
Northwest 0.9x	0.77	x	3.7	x	91.1	x	0.55	x	0.7	=	179.87	(81)
Northwest 0.9x	0.77	x	0.91	x	91.1	x	0.55	x	0.7	=	22.12	(81)
Northwest 0.9x	0.77	x	6.29	x	91.1	x	0.55	x	0.7	=	152.89	(81)
Northwest 0.9x	0.77	x	3.7	x	72.63	x	0.55	x	0.7	=	143.39	(81)
Northwest 0.9x	0.77	x	0.91	x	72.63	x	0.55	x	0.7	=	17.63	(81)
Northwest 0.9x	0.77	x	6.29	x	72.63	x	0.55	x	0.7	=	121.88	(81)
Northwest 0.9x	0.77	x	3.7	x	50.42	x	0.55	x	0.7	=	99.55	(81)
Northwest 0.9x	0.77	x	0.91	x	50.42	x	0.55	x	0.7	=	12.24	(81)
Northwest 0.9x	0.77	x	6.29	x	50.42	x	0.55	x	0.7	=	84.62	(81)
Northwest 0.9x	0.77	x	3.7	x	28.07	x	0.55	x	0.7	=	55.41	(81)
Northwest 0.9x	0.77	x	0.91	x	28.07	x	0.55	x	0.7	=	6.81	(81)
Northwest 0.9x	0.77	x	6.29	x	28.07	x	0.55	x	0.7	=	47.1	(81)
Northwest 0.9x	0.77	x	3.7	x	14.2	x	0.55	x	0.7	=	28.03	(81)
Northwest 0.9x	0.77	x	0.91	x	14.2	x	0.55	x	0.7	=	3.45	(81)
Northwest 0.9x	0.77	x	6.29	x	14.2	x	0.55	x	0.7	=	23.83	(81)
Northwest 0.9x	0.77	x	3.7	x	9.21	x	0.55	x	0.7	=	18.19	(81)
Northwest 0.9x	0.77	x	0.91	x	9.21	x	0.55	x	0.7	=	2.24	(81)
Northwest 0.9x	0.77	x	6.29	x	9.21	x	0.55	x	0.7	=	15.46	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	187.86	334.6	496.59	680.3	821.32	841.47	800.41	691.22	559.58	380.26	227.68	159.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	511.78	656.13	806.39	971.59	1093.99	1096.03	1043.45	940.08	818.13	657.51	526.32	473.73	(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	0.94	0.83	0.65	0.47	0.34	0.4	0.65	0.91	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.96	20.33	20.71	20.92	20.98	21	20.99	20.94	20.61	20.06	19.63	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.79	19.79	19.79	19.8	19.8	19.82	19.82	19.82	19.81	19.8	19.8	19.8	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.97	0.92	0.79	0.58	0.39	0.25	0.3	0.55	0.87	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.07	18.47	18.99	19.5	19.74	19.81	19.81	19.82	19.77	19.4	18.63	18	(90)

fLA = Living area ÷ (4) = | 0.5 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

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(92)m=	18.87	19.21	19.65	20.1	20.32	20.39	20.4	20.4	20.35	20	19.34	18.81	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.72	19.06	19.5	19.95	20.17	20.24	20.25	20.25	20.2	19.85	19.19	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	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.91	0.79	0.61	0.42	0.29	0.33	0.58	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	504.96	633.5	736.74	768.49	662.54	456.2	298.17	313.05	478.17	573.42	511.5	469.03	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1213.09	1188.4	1089.18	915.9	700.88	461.84	298.96	314.61	501.74	765.11	1004.41	1206.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	526.85	372.89	262.22	106.14	28.52	0	0	0	0	142.62	354.89	548.54	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2342.67 (98)

Space heating requirement in kWh/m²/year 38.15 (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		90.3	(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)													
	526.85	372.89	262.22	106.14	28.52	0	0	0	0	142.62	354.89	548.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	583.44	412.95	290.38	117.54	31.59	0	0	0	0	157.94	393.02	607.46	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 2594.32 (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)

	180.16	157.38	163.74	145.23	140.61	123.84	118.65	132.26	133.72	152.27	162.55	175.93

Efficiency of water heater 81 (216)

(217)m=	87.73	87.32	86.48	84.68	82.43	81	81	81	81	85.25	87.16	87.85	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	205.35	180.22	189.33	171.5	170.57	152.89	146.48	163.29	165.09	178.63	186.5	200.26

Total = $Sum(219a)_{1...12}$ = 2110.1 (219)

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Annual totals		kWh/year	kWh/year	
Space heating fuel used, main system 1			2594.32	
Water heating fuel used			2110.1	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		133.99		(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) =		208.99	(231)
Electricity for lighting			277.83	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	560.37	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	455.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1016.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	108.47	(267)
Electricity for lighting	(232) x	0.519	=	144.19	(268)
Total CO2, kg/year		sum of (265)…(271) =		1268.81	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.66	(273)
EI rating (section 14)				84	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.4	(1a) x	2.7	(2a) =	203.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.58	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.14	(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
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	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) = 74.8 (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	0.25	0.26	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	0.25	0.26	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	x	1.3	=	2.6			(26)
Windows Type 1			1.27	x1/[1/(1.3)+ 0.04]		=	1.57			(27)
Windows Type 2			2.7	x1/[1/(1.3)+ 0.04]		=	3.34			(27)
Windows Type 3			2.22	x1/[1/(1.3)+ 0.04]		=	2.74			(27)
Windows Type 4			2.78	x1/[1/(1.3)+ 0.04]		=	3.44			(27)
Windows Type 5			7.75	x1/[1/(1.3)+ 0.04]		=	9.58			(27)
Windows Type 6			1.19	x1/[1/(1.3)+ 0.04]		=	1.47			(27)
Windows Type 7			2	x1/[1/(1.3)+ 0.04]		=	2.47			(27)
Rooflights			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Walls Type1	68.45	21.91	46.54	x	0.15	=	6.98			(29)
Walls Type2	4.03	2	2.03	x	0.13	=	0.27			(29)
Roof	75.4	1.05	74.35	x	0.1	=	7.44			(30)
Total area of elements, m²			147.88							(31)
Party wall			42.95	x	0	=	0			(32)
Party floor			75.4							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.94 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13772.45 (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 | 17.49 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 63.43 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	20.35	20.12	19.88	18.72	18.49	17.32	17.32	17.09	17.79	18.49	18.95	19.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	83.78	83.55	83.32	82.15	81.92	80.75	80.75	80.52	81.22	81.92	82.38	82.85

Average = $Sum(39)_{1...12}$ /12= | 82.09 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1

Average = $Sum(40)_{1...12}$ /12= | 1.09 | (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 | 2.37 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 90.48 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	99.53	95.91	92.29	88.67	85.05	81.43	81.43	85.05	88.67	92.29	95.91	99.53

Total = $Sum(44)_{1...12}$ = | 1085.79 | (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=	147.6	129.09	133.21	116.14	111.44	96.16	89.11	102.25	103.47	120.59	131.63	142.94

Total = $Sum(45)_{1...12}$ = | 1423.64 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.14	19.36	19.98	17.42	16.72	14.42	13.37	15.34	15.52	18.09	19.74	21.44	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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Energy lost from water storage, kWh/year	(47) 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) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.72	44.15	47.03	43.73	43.34	40.16	41.5	43.34	43.73	47.03	47.3	50.72	(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=	198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66	(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=	198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66	

Output from water heater (annual)$_{1...12}$ 1966.39 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	61.76	53.96	56.05	49.55	47.89	42.01	40	44.83	45.34	51.85	55.59	60.21	(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=	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.68	16.59	13.49	10.22	7.64	6.45	6.97	9.06	12.15	15.43	18.01	19.2	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	209.56	211.73	206.25	194.59	179.86	166.02	156.78	154.6	160.08	171.75	186.47	200.31	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	(71)

Water heating gains (Table 5)

(72)m=	83.01	80.3	75.34	68.82	64.37	58.35	53.77	60.26	62.97	69.7	77.21	80.93	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	372.8	370.17	356.63	335.17	313.41	292.37	279.06	285.46	296.75	318.42	343.24	361.99	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	7.75	x	11.28	x	0.55	x	0.7	=	23.33	(75)
Northeast	0.9x	0.77	x	1.19	x	11.28	x	0.55	x	0.7	=	3.58	(75)
Northeast	0.9x	0.77	x	7.75	x	22.97	x	0.55	x	0.7	=	47.49	(75)
Northeast	0.9x	0.77	x	1.19	x	22.97	x	0.55	x	0.7	=	7.29	(75)
Northeast	0.9x	0.77	x	7.75	x	41.38	x	0.55	x	0.7	=	85.56	(75)
Northeast	0.9x	0.77	x	1.19	x	41.38	x	0.55	x	0.7	=	13.14	(75)
Northeast	0.9x	0.77	x	7.75	x	67.96	x	0.55	x	0.7	=	140.51	(75)
Northeast	0.9x	0.77	x	1.19	x	67.96	x	0.55	x	0.7	=	21.58	(75)
Northeast	0.9x	0.77	x	7.75	x	91.35	x	0.55	x	0.7	=	188.88	(75)
Northeast	0.9x	0.77	x	1.19	x	91.35	x	0.55	x	0.7	=	29	(75)
Northeast	0.9x	0.77	x	7.75	x	97.38	x	0.55	x	0.7	=	201.37	(75)
Northeast	0.9x	0.77	x	1.19	x	97.38	x	0.55	x	0.7	=	30.92	(75)
Northeast	0.9x	0.77	x	7.75	x	91.1	x	0.55	x	0.7	=	188.37	(75)
Northeast	0.9x	0.77	x	1.19	x	91.1	x	0.55	x	0.7	=	28.92	(75)
Northeast	0.9x	0.77	x	7.75	x	72.63	x	0.55	x	0.7	=	150.17	(75)
Northeast	0.9x	0.77	x	1.19	x	72.63	x	0.55	x	0.7	=	23.06	(75)
Northeast	0.9x	0.77	x	7.75	x	50.42	x	0.55	x	0.7	=	104.26	(75)
Northeast	0.9x	0.77	x	1.19	x	50.42	x	0.55	x	0.7	=	16.01	(75)
Northeast	0.9x	0.77	x	7.75	x	28.07	x	0.55	x	0.7	=	58.04	(75)
Northeast	0.9x	0.77	x	1.19	x	28.07	x	0.55	x	0.7	=	8.91	(75)
Northeast	0.9x	0.77	x	7.75	x	14.2	x	0.55	x	0.7	=	29.36	(75)
Northeast	0.9x	0.77	x	1.19	x	14.2	x	0.55	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	7.75	x	9.21	x	0.55	x	0.7	=	19.05	(75)
Northeast	0.9x	0.77	x	1.19	x	9.21	x	0.55	x	0.7	=	2.93	(75)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.55	x	0.7	=	39.27	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.55	x	0.7	=	66.89	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.55	x	0.7	=	91.52	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.55	x	0.7	=	113.39	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.55	x	0.7	=	127.01	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.55	x	0.7	=	126.09	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.55	x	0.7	=	121.57	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.55	x	0.7	=	111.41	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.55	x	0.7	=	99.09	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.55	x	0.7	=	73.92	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.55	x	0.7	=	47.03	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.55	x	0.7	=	33.6	(77)
Southwest	0.9x	0.77	x	1.27	x	36.79		0.55	x	0.7	=	12.47	(79)
Southwest	0.9x	0.77	x	2.7	x	36.79		0.55	x	0.7	=	26.51	(79)
Southwest	0.9x	0.77	x	2.22	x	36.79		0.55	x	0.7	=	21.79	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	2.78	x	36.79		0.55	x	0.7	=	27.29	(79)
Southwest	0.9x	0.77	x	1.27	x	62.67		0.55	x	0.7	=	21.24	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67		0.55	x	0.7	=	45.15	(79)
Southwest	0.9x	0.77	x	2.22	x	62.67		0.55	x	0.7	=	37.12	(79)
Southwest	0.9x	0.77	x	2.78	x	62.67		0.55	x	0.7	=	46.49	(79)
Southwest	0.9x	0.77	x	1.27	x	85.75		0.55	x	0.7	=	29.06	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75		0.55	x	0.7	=	61.77	(79)
Southwest	0.9x	0.77	x	2.22	x	85.75		0.55	x	0.7	=	50.79	(79)
Southwest	0.9x	0.77	x	2.78	x	85.75		0.55	x	0.7	=	63.6	(79)
Southwest	0.9x	0.77	x	1.27	x	106.25		0.55	x	0.7	=	36	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25		0.55	x	0.7	=	76.54	(79)
Southwest	0.9x	0.77	x	2.22	x	106.25		0.55	x	0.7	=	62.93	(79)
Southwest	0.9x	0.77	x	2.78	x	106.25		0.55	x	0.7	=	78.81	(79)
Southwest	0.9x	0.77	x	1.27	x	119.01		0.55	x	0.7	=	40.33	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01		0.55	x	0.7	=	85.73	(79)
Southwest	0.9x	0.77	x	2.22	x	119.01		0.55	x	0.7	=	70.49	(79)
Southwest	0.9x	0.77	x	2.78	x	119.01		0.55	x	0.7	=	88.27	(79)
Southwest	0.9x	0.77	x	1.27	x	118.15		0.55	x	0.7	=	40.03	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15		0.55	x	0.7	=	85.11	(79)
Southwest	0.9x	0.77	x	2.22	x	118.15		0.55	x	0.7	=	69.98	(79)
Southwest	0.9x	0.77	x	2.78	x	118.15		0.55	x	0.7	=	87.63	(79)
Southwest	0.9x	0.77	x	1.27	x	113.91		0.55	x	0.7	=	38.6	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91		0.55	x	0.7	=	82.06	(79)
Southwest	0.9x	0.77	x	2.22	x	113.91		0.55	x	0.7	=	67.47	(79)
Southwest	0.9x	0.77	x	2.78	x	113.91		0.55	x	0.7	=	84.49	(79)
Southwest	0.9x	0.77	x	1.27	x	104.39		0.55	x	0.7	=	35.37	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39		0.55	x	0.7	=	75.2	(79)
Southwest	0.9x	0.77	x	2.22	x	104.39		0.55	x	0.7	=	61.83	(79)
Southwest	0.9x	0.77	x	2.78	x	104.39		0.55	x	0.7	=	77.43	(79)
Southwest	0.9x	0.77	x	1.27	x	92.85		0.55	x	0.7	=	31.46	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85		0.55	x	0.7	=	66.89	(79)
Southwest	0.9x	0.77	x	2.22	x	92.85		0.55	x	0.7	=	55	(79)
Southwest	0.9x	0.77	x	2.78	x	92.85		0.55	x	0.7	=	68.87	(79)
Southwest	0.9x	0.77	x	1.27	x	69.27		0.55	x	0.7	=	23.47	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27		0.55	x	0.7	=	49.9	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27		0.55	x	0.7	=	41.03	(79)
Southwest	0.9x	0.77	x	2.78	x	69.27		0.55	x	0.7	=	51.38	(79)
Southwest	0.9x	0.77	x	1.27	x	44.07		0.55	x	0.7	=	14.93	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07		0.55	x	0.7	=	31.75	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07		0.55	x	0.7	=	26.1	(79)
Southwest	0.9x	0.77	x	2.78	x	44.07		0.55	x	0.7	=	32.69	(79)

Southwest	0.9x	0.77	x	1.27	x	31.49		0.55	x	0.7	=	10.67	(79)
Southwest	0.9x	0.77	x	2.7	x	31.49		0.55	x	0.7	=	22.68	(79)
Southwest	0.9x	0.77	x	2.22	x	31.49		0.55	x	0.7	=	18.65	(79)
Southwest	0.9x	0.77	x	2.78	x	31.49		0.55	x	0.7	=	23.36	(79)
Rooflights	0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights	0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)
Rooflights	0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights	0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights	0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights	0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights	0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights	0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights	0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights	0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights	0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights	0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	165.05	294.11	435.36	592.14	709.55	724.3	690.06	599.75	489.39	334.09	200.09	139.67	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	537.84	664.29	791.99	927.31	1022.96	1016.67	969.12	885.22	786.14	652.51	543.33	501.66	(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	0.87	0.7	0.5	0.37	0.42	0.67	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.92	20.13	20.44	20.76	20.94	20.99	21	21	20.96	20.69	20.24	19.88	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	19.99	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.83	0.64	0.43	0.29	0.33	0.59	0.9	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.56	18.88	19.31	19.75	19.96	20.02	20.02	20.03	19.99	19.67	19.03	18.51	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.04	19.32	19.71	20.11	20.31	20.36	20.37	20.37	20.34	20.04	19.46	19	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.89	19.17	19.56	19.96	20.16	20.21	20.22	20.22	20.19	19.89	19.31	18.85	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.94	0.83	0.65	0.44	0.3	0.35	0.61	0.9	0.98	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	533.48	649.67	743.75	770.86	661.21	449.93	291.98	306.94	477.75	585.42	533.19	498.7	(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=	1222.44	1192.46	1087.89	908.57	692.72	453.37	292.33	307.66	494.35	760.62	1005.91	1213.46	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	512.58	364.76	256.04	99.16	23.44	0	0	0	0	130.35	340.36	531.78

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2258.47 (98)

Space heating requirement in kWh/m²/year 29.95 (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		90.3	(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)	512.58	364.76	256.04	99.16	23.44	0	0	0	0	130.35	340.36	531.78	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	567.64	403.94	283.54	109.81	25.96	0	0	0	0	144.35	376.92	588.9	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2501.07 (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)

198.32	173.24	180.24	159.87	154.78	136.32	130.61	145.6	147.2	167.62	178.93	193.66

Efficiency of water heater 81 (216)

(217)m=	87.5	87.08	86.21	84.32	82.11	81	81	81	81	84.82	86.86	87.61	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	226.66	198.94	209.07	189.59	188.5	168.3	161.24	179.75	181.73	197.61	205.99	221.04

Total = Sum(219a)$_{1...12}$ = 2328.42 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2501.07
Water heating fuel used		2328.42
Electricity for pumps, fans and electric keep-hot		

mechanical ventilation - balanced, extract or positive input from outside		186.28		(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) =		261.28	(231)
Electricity for lighting			329.94	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	540.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	502.94	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1043.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	135.6	(267)
Electricity for lighting	(232) x	0.519	=	171.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		1350.01	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		17.9	(273)
EI rating (section 14)				85	(274)

SAP Worksheets
Energy Statement
34A-36 Kilburn High Road

Green DER Worksheets

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.17	(1a)	x	2.7	(2a)	=	135.46	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.17	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	135.46	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.14	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	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) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.3	0.3	0.29	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 × (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	0.29	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	x	1.3	=	2.6			(26)
Windows Type 1			9.56	x1/[1/(1.3)+ 0.04]		=	11.81			(27)
Windows Type 2			4.62	x1/[1/(1.3)+ 0.04]		=	5.71			(27)
Windows Type 3			4.17	x1/[1/(1.3)+ 0.04]		=	5.15			(27)
Rooflights Type 1			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Rooflights Type 2			1.79	x1/[1/(1.6) + 0.04]		=	2.864			(27b)
Walls Type1	35.48	22.52	12.96	x	0.15	=	1.94			(29)
Walls Type2	30.48	2	28.48	x	0.13	=	3.8			(29)
Roof	50.17	2.84	47.33	x	0.1	=	4.73			(30)
Total area of elements, m²			116.13							(31)
Party wall			26.97	x	0	=	0			(32)
Party floor			50.17							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 10845.77 (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 14.19 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	59.37	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	13.35	13.2	13.04	12.26	12.11	11.33	11.33	11.18	11.64	12.11	12.42	12.73	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	72.72	72.57	72.41	71.64	71.48	70.71	70.71	70.55	71.02	71.48	71.79	72.1	

Average = Sum(39)$_{1...12}$ /12= 71.6 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.45	1.45	1.44	1.43	1.42	1.41	1.41	1.41	1.42	1.42	1.43	1.44	

Average = Sum(40)$_{1...12}$ /12= 1.43 (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 — 1.7 (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 — 74.46 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	81.9	78.93	75.95	72.97	69.99	67.01	67.01	69.99	72.97	75.95	78.93	81.9	

Total = Sum(44)$_{1...12}$ = 893.51 (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=	121.46	106.23	109.62	95.57	91.7	79.13	73.33	84.14	85.15	99.23	108.32	117.63	

Total = Sum(45)$_{1...12}$ = 1171.53 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.22	15.93	16.44	14.34	13.76	11.87	11	12.62	12.77	14.89	16.25	17.64	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	176.74	156.16	164.9	149.06	146.98	132.63	128.6	139.42	138.64	154.51	161.81	172.91	(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=	176.74	156.16	164.9	149.06	146.98	132.63	128.6	139.42	138.64	154.51	161.81	172.91

Output from water heater (annual)1…12 | 1822.37 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.61	75.26	80.67	74.57	74.71	69.11	68.6	72.2	71.11	77.22	78.81	83.33	(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=	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	84.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.17	11.69	9.51	7.2	5.38	4.54	4.91	6.38	8.57	10.88	12.69	13.53	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.68	149.21	145.35	137.13	126.75	116.99	110.48	108.95	112.81	121.03	131.41	141.16	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	31.48	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	-67.8	(71)

Water heating gains (Table 5)

(72)m=	113.72	112	108.43	103.57	100.42	95.98	92.21	97.04	98.76	103.79	109.46	112.01	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	322.99	321.33	311.71	296.32	280.98	265.95	256.02	260.8	268.56	284.12	301.99	315.12	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	9.56	x	11.28	x	0.55	x	0.7	=	28.78	(75)
Northeast	0.9x	0.77	x	4.62	x	11.28	x	0.55	x	0.7	=	13.91	(75)
Northeast	0.9x	0.77	x	9.56	x	22.97	x	0.55	x	0.7	=	58.58	(75)
Northeast	0.9x	0.77	x	4.62	x	22.97	x	0.55	x	0.7	=	28.31	(75)
Northeast	0.9x	0.77	x	9.56	x	41.38	x	0.55	x	0.7	=	105.54	(75)
Northeast	0.9x	0.77	x	4.62	x	41.38	x	0.55	x	0.7	=	51.01	(75)
Northeast	0.9x	0.77	x	9.56	x	67.96	x	0.55	x	0.7	=	173.33	(75)
Northeast	0.9x	0.77	x	4.62	x	67.96	x	0.55	x	0.7	=	83.77	(75)
Northeast	0.9x	0.77	x	9.56	x	91.35	x	0.55	x	0.7	=	232.99	(75)
Northeast	0.9x	0.77	x	4.62	x	91.35	x	0.55	x	0.7	=	112.6	(75)
Northeast	0.9x	0.77	x	9.56	x	97.38	x	0.55	x	0.7	=	248.39	(75)
Northeast	0.9x	0.77	x	4.62	x	97.38	x	0.55	x	0.7	=	120.04	(75)
Northeast	0.9x	0.77	x	9.56	x	91.1	x	0.55	x	0.7	=	232.37	(75)
Northeast	0.9x	0.77	x	4.62	x	91.1	x	0.55	x	0.7	=	112.29	(75)
Northeast	0.9x	0.77	x	9.56	x	72.63	x	0.55	x	0.7	=	185.25	(75)
Northeast	0.9x	0.77	x	4.62	x	72.63	x	0.55	x	0.7	=	89.52	(75)
Northeast	0.9x	0.77	x	9.56	x	50.42	x	0.55	x	0.7	=	128.61	(75)
Northeast	0.9x	0.77	x	4.62	x	50.42	x	0.55	x	0.7	=	62.15	(75)
Northeast	0.9x	0.77	x	9.56	x	28.07	x	0.55	x	0.7	=	71.59	(75)
Northeast	0.9x	0.77	x	4.62	x	28.07	x	0.55	x	0.7	=	34.6	(75)
Northeast	0.9x	0.77	x	9.56	x	14.2	x	0.55	x	0.7	=	36.21	(75)
Northeast	0.9x	0.77	x	4.62	x	14.2	x	0.55	x	0.7	=	17.5	(75)
Northeast	0.9x	0.77	x	9.56	x	9.21	x	0.55	x	0.7	=	23.5	(75)
Northeast	0.9x	0.77	x	4.62	x	9.21	x	0.55	x	0.7	=	11.36	(75)
Northwest	0.9x	0.77	x	4.17	x	11.28	x	0.55	x	0.7	=	25.11	(81)
Northwest	0.9x	0.77	x	4.17	x	22.97	x	0.55	x	0.7	=	51.1	(81)
Northwest	0.9x	0.77	x	4.17	x	41.38	x	0.55	x	0.7	=	92.07	(81)
Northwest	0.9x	0.77	x	4.17	x	67.96	x	0.55	x	0.7	=	151.21	(81)
Northwest	0.9x	0.77	x	4.17	x	91.35	x	0.55	x	0.7	=	203.26	(81)
Northwest	0.9x	0.77	x	4.17	x	97.38	x	0.55	x	0.7	=	216.7	(81)
Northwest	0.9x	0.77	x	4.17	x	91.1	x	0.55	x	0.7	=	202.71	(81)
Northwest	0.9x	0.77	x	4.17	x	72.63	x	0.55	x	0.7	=	161.61	(81)
Northwest	0.9x	0.77	x	4.17	x	50.42	x	0.55	x	0.7	=	112.19	(81)
Northwest	0.9x	0.77	x	4.17	x	28.07	x	0.55	x	0.7	=	62.45	(81)
Northwest	0.9x	0.77	x	4.17	x	14.2	x	0.55	x	0.7	=	31.59	(81)
Northwest	0.9x	0.77	x	4.17	x	9.21	x	0.55	x	0.7	=	20.5	(81)
Rooflights	0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights	0.9x	1	x	1.79	x	26	x	0.55	x	0.8	=	18.43	(82)
Rooflights	0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)

Rooflights 0.9x	1	x	1.79	x	54	x	0.55	x	0.8	=	38.28	(82)
Rooflights 0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights 0.9x	1	x	1.79	x	96	x	0.55	x	0.8	=	68.05	(82)
Rooflights 0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights 0.9x	1	x	1.79	x	150	x	0.55	x	0.8	=	106.33	(82)
Rooflights 0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights 0.9x	1	x	1.79	x	192	x	0.55	x	0.8	=	136.1	(82)
Rooflights 0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights 0.9x	1	x	1.79	x	200	x	0.55	x	0.8	=	141.77	(82)
Rooflights 0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights 0.9x	1	x	1.79	x	189	x	0.55	x	0.8	=	133.97	(82)
Rooflights 0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights 0.9x	1	x	1.79	x	157	x	0.55	x	0.8	=	111.29	(82)
Rooflights 0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights 0.9x	1	x	1.79	x	115	x	0.55	x	0.8	=	81.52	(82)
Rooflights 0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights 0.9x	1	x	1.79	x	66	x	0.55	x	0.8	=	46.78	(82)
Rooflights 0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights 0.9x	1	x	1.79	x	33	x	0.55	x	0.8	=	23.39	(82)
Rooflights 0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)
Rooflights 0.9x	1	x	1.79	x	21	x	0.55	x	0.8	=	14.89	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	97.03	198.73	356.59	577.01	764.78	810.06	759.93	612.94	432.28	242.87	122.41	78.98	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.02	520.05	668.3	873.33	1045.75	1076	1015.96	873.74	700.84	526.98	424.4	394.11	(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	0.81	0.6	0.41	0.3	0.37	0.65	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.58	19.83	20.25	20.71	20.93	20.99	21	20.99	20.93	20.54	19.97	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.73	19.73	19.73	19.74	19.74	19.76	19.76	19.76	19.75	19.74	19.74	19.73	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.92	0.76	0.53	0.34	0.22	0.27	0.55	0.89	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.89	18.25	18.84	19.45	19.69	19.75	19.76	19.76	19.71	19.26	18.46	17.84	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.69	19	19.51	20.04	20.28	20.34	20.34	20.34	20.29	19.86	19.17	18.64	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.69	19	19.51	20.04	20.28	20.34	20.34	20.34	20.29	19.86	19.17	18.64	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.92	0.77	0.56	0.37	0.26	0.32	0.59	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	414.51	504.69	613.26	673.54	585.13	401.68	264.04	276.75	414.99	468.59	413.61	390.03	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1046.57	1022.97	941.87	798.28	613.04	405.56	264.66	278.14	439.39	662.11	866.57	1041.35	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	470.25	348.29	244.48	89.81	20.77	0	0	0	0	143.97	326.13	484.58	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2128.29 (98)

Space heating requirement in kWh/m²/year 42.42 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.7	(303a)
Fraction of community heat from heat source 2 (Water)		0.3	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2128.29	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2234.71	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1822.37	
If DHW from community scheme:			
Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1339.44	(310a)

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Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	574.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	22.35	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	19.13	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		109.48	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	109.48	(331)
Energy for lighting (calculated in Appendix L)		232.5	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-684.44	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	386.6	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	11.6	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	231.72	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	297.93	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	9.93	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	937.79	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				937.79	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	56.82	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	120.67	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-355.23	(380)
Total CO2, kg/year	sum of (376)…(382) =				760.05	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.15	(384)

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EI rating (section 14)	89.3	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	59.25	(1a)	x	2.7	(2a)	=	159.98	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.25	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	159.98	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.12	(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

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

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) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	1.3	=	2.6			(26)
Windows Type 1			8.26	x1/[1/(1.3)+ 0.04]		=	10.21			(27)
Windows Type 2			4.21	x1/[1/(1.3)+ 0.04]		=	5.2			(27)
Windows Type 3			3.21	x1/[1/(1.3)+ 0.04]		=	3.97			(27)
Windows Type 4			4.37	x1/[1/(1.3)+ 0.04]		=	5.4			(27)
Rooflights			1.61	x1/[1/(1.6) + 0.04]		=	2.576			(27b)
Walls Type1	38.95	20.05	18.9	x	0.15	=	2.84			(29)
Walls Type2	45.47	2	43.47	x	0.13	=	5.81			(29)
Roof	59.25	1.61	57.64	x	0.1	=	5.76			(30)
Total area of elements, m²			143.67							(31)
Party wall			25.95	x	0	=	0			(32)
Party floor			59.25							(32a)

** 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) = 44.2 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15258.06 (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 14.56 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	58.77 (37)
Ventilation heat loss calculated monthly	(38)m = 0.33 × (25)m x (5)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.25	14.1	13.95	13.18	13.02	12.26	12.26	12.1	12.56	13.02	13.33	13.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.02	72.86	72.71	71.94	71.79	71.02	71.02	70.87	71.33	71.79	72.1	72.4	

Average = Sum(39)$_{1...12}$ /12= 71.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.23	1.21	1.21	1.2	1.2	1.2	1.2	1.21	1.22	1.22	

Average = Sum(40)$_{1...12}$ /12= 1.21 (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 — 1.96 (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 — 80.76 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	88.83	85.6	82.37	79.14	75.91	72.68	72.68	75.91	79.14	82.37	85.6	88.83	

Total = Sum(44)$_{1...12}$ = 969.1 (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=	131.74	115.22	118.9	103.66	99.46	85.83	79.53	91.26	92.35	107.63	117.49	127.58	

Total = Sum(45)$_{1...12}$ = 1270.64 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.76	17.28	17.83	15.55	14.92	12.87	11.93	13.69	13.85	16.14	17.62	19.14	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)			
Water storage loss:			
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	187.02	165.15	174.17	157.15	154.74	139.32	134.81	146.54	145.85	162.91	170.98	182.86	(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=	187.02	165.15	174.17	157.15	154.74	139.32	134.81	146.54	145.85	162.91	170.98	182.86

Output from water heater (annual)$_{1\ldots12}$ | 1921.48 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	88.02	78.25	83.75	77.26	77.29	71.33	70.67	74.57	73.5	80.01	81.86	86.64	(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=	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	98.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.25	13.54	11.02	8.34	6.23	5.26	5.69	7.39	9.92	12.6	14.7	15.67	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	171.05	172.83	168.35	158.83	146.81	135.51	127.97	126.19	130.66	140.19	152.21	163.5	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	32.8	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	-78.41	(71)

Water heating gains (Table 5)

(72)m=	118.31	116.45	112.57	107.31	103.89	99.07	94.98	100.22	102.09	107.54	113.69	116.45	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	357.02	355.22	344.35	326.88	309.34	292.25	281.04	286.21	295.08	312.73	333.01	348.04	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	4.21	x	11.28	x	0.55	x	0.7	=	12.67	(75)
Northeast 0.9x	0.77	x	4.21	x	22.97	x	0.55	x	0.7	=	25.8	(75)
Northeast 0.9x	0.77	x	4.21	x	41.38	x	0.55	x	0.7	=	46.48	(75)
Northeast 0.9x	0.77	x	4.21	x	67.96	x	0.55	x	0.7	=	76.33	(75)
Northeast 0.9x	0.77	x	4.21	x	91.35	x	0.55	x	0.7	=	102.6	(75)
Northeast 0.9x	0.77	x	4.21	x	97.38	x	0.55	x	0.7	=	109.39	(75)
Northeast 0.9x	0.77	x	4.21	x	91.1	x	0.55	x	0.7	=	102.33	(75)
Northeast 0.9x	0.77	x	4.21	x	72.63	x	0.55	x	0.7	=	81.58	(75)
Northeast 0.9x	0.77	x	4.21	x	50.42	x	0.55	x	0.7	=	56.63	(75)
Northeast 0.9x	0.77	x	4.21	x	28.07	x	0.55	x	0.7	=	31.53	(75)
Northeast 0.9x	0.77	x	4.21	x	14.2	x	0.55	x	0.7	=	15.95	(75)
Northeast 0.9x	0.77	x	4.21	x	9.21	x	0.55	x	0.7	=	10.35	(75)
Northwest 0.9x	0.77	x	8.26	x	11.28	x	0.55	x	0.7	=	24.87	(81)
Northwest 0.9x	0.77	x	3.21	x	11.28	x	0.55	x	0.7	=	9.66	(81)
Northwest 0.9x	0.77	x	4.37	x	11.28	x	0.55	x	0.7	=	13.16	(81)
Northwest 0.9x	0.77	x	8.26	x	22.97	x	0.55	x	0.7	=	50.61	(81)
Northwest 0.9x	0.77	x	3.21	x	22.97	x	0.55	x	0.7	=	19.67	(81)
Northwest 0.9x	0.77	x	4.37	x	22.97	x	0.55	x	0.7	=	26.78	(81)
Northwest 0.9x	0.77	x	8.26	x	41.38	x	0.55	x	0.7	=	91.19	(81)
Northwest 0.9x	0.77	x	3.21	x	41.38	x	0.55	x	0.7	=	35.44	(81)
Northwest 0.9x	0.77	x	4.37	x	41.38	x	0.55	x	0.7	=	48.25	(81)
Northwest 0.9x	0.77	x	8.26	x	67.96	x	0.55	x	0.7	=	149.76	(81)
Northwest 0.9x	0.77	x	3.21	x	67.96	x	0.55	x	0.7	=	58.2	(81)
Northwest 0.9x	0.77	x	4.37	x	67.96	x	0.55	x	0.7	=	79.23	(81)
Northwest 0.9x	0.77	x	8.26	x	91.35	x	0.55	x	0.7	=	201.31	(81)
Northwest 0.9x	0.77	x	3.21	x	91.35	x	0.55	x	0.7	=	78.23	(81)
Northwest 0.9x	0.77	x	4.37	x	91.35	x	0.55	x	0.7	=	106.5	(81)
Northwest 0.9x	0.77	x	8.26	x	97.38	x	0.55	x	0.7	=	214.62	(81)
Northwest 0.9x	0.77	x	3.21	x	97.38	x	0.55	x	0.7	=	83.4	(81)
Northwest 0.9x	0.77	x	4.37	x	97.38	x	0.55	x	0.7	=	113.54	(81)
Northwest 0.9x	0.77	x	8.26	x	91.1	x	0.55	x	0.7	=	200.77	(81)
Northwest 0.9x	0.77	x	3.21	x	91.1	x	0.55	x	0.7	=	78.02	(81)
Northwest 0.9x	0.77	x	4.37	x	91.1	x	0.55	x	0.7	=	106.22	(81)
Northwest 0.9x	0.77	x	8.26	x	72.63	x	0.55	x	0.7	=	160.06	(81)
Northwest 0.9x	0.77	x	3.21	x	72.63	x	0.55	x	0.7	=	62.2	(81)
Northwest 0.9x	0.77	x	4.37	x	72.63	x	0.55	x	0.7	=	84.68	(81)
Northwest 0.9x	0.77	x	8.26	x	50.42	x	0.55	x	0.7	=	111.12	(81)
Northwest 0.9x	0.77	x	3.21	x	50.42	x	0.55	x	0.7	=	43.18	(81)
Northwest 0.9x	0.77	x	4.37	x	50.42	x	0.55	x	0.7	=	58.79	(81)

Northwest 0.9x	0.77	x	8.26	x	28.07	x	0.55	x	0.7	=	61.85	(81)
Northwest 0.9x	0.77	x	3.21	x	28.07	x	0.55	x	0.7	=	24.04	(81)
Northwest 0.9x	0.77	x	4.37	x	28.07	x	0.55	x	0.7	=	32.72	(81)
Northwest 0.9x	0.77	x	8.26	x	14.2	x	0.55	x	0.7	=	31.29	(81)
Northwest 0.9x	0.77	x	3.21	x	14.2	x	0.55	x	0.7	=	12.16	(81)
Northwest 0.9x	0.77	x	4.37	x	14.2	x	0.55	x	0.7	=	16.55	(81)
Northwest 0.9x	0.77	x	8.26	x	9.21	x	0.55	x	0.7	=	20.31	(81)
Northwest 0.9x	0.77	x	3.21	x	9.21	x	0.55	x	0.7	=	7.89	(81)
Northwest 0.9x	0.77	x	4.37	x	9.21	x	0.55	x	0.7	=	10.74	(81)
Rooflights 0.9x	1	x	1.61	x	26	x	0.55	x	0.8	=	16.58	(82)
Rooflights 0.9x	1	x	1.61	x	54	x	0.55	x	0.8	=	34.43	(82)
Rooflights 0.9x	1	x	1.61	x	96	x	0.55	x	0.8	=	61.21	(82)
Rooflights 0.9x	1	x	1.61	x	150	x	0.55	x	0.8	=	95.63	(82)
Rooflights 0.9x	1	x	1.61	x	192	x	0.55	x	0.8	=	122.41	(82)
Rooflights 0.9x	1	x	1.61	x	200	x	0.55	x	0.8	=	127.51	(82)
Rooflights 0.9x	1	x	1.61	x	189	x	0.55	x	0.8	=	120.5	(82)
Rooflights 0.9x	1	x	1.61	x	157	x	0.55	x	0.8	=	100.1	(82)
Rooflights 0.9x	1	x	1.61	x	115	x	0.55	x	0.8	=	73.32	(82)
Rooflights 0.9x	1	x	1.61	x	66	x	0.55	x	0.8	=	42.08	(82)
Rooflights 0.9x	1	x	1.61	x	33	x	0.55	x	0.8	=	21.04	(82)
Rooflights 0.9x	1	x	1.61	x	21	x	0.55	x	0.8	=	13.39	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	76.93	157.29	282.56	459.16	611.06	648.46	607.84	488.61	343.04	192.22	96.98	62.68	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	433.95	512.51	626.91	786.04	920.4	940.72	888.88	774.82	638.12	504.95	429.99	410.72	(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	0.87	0.68	0.48	0.35	0.42	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=	19.77	19.96	20.3	20.7	20.93	20.99	21	21	20.94	20.58	20.1	19.74	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.89	19.9	19.9	19.91	19.91	19.92	19.92	19.92	19.92	19.91	19.91	19.9	(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	0.62	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=	18.28	18.55	19.04	19.59	19.85	19.91	19.92	19.92	19.87	19.44	18.76	18.23	(90)

fLA = Living area ÷ (4) = 0.47 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.97	19.21	19.63	20.11	20.35	20.42	20.42	20.42	20.37	19.97	19.39	18.94	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.97	19.21	19.63	20.11	20.35	20.42	20.42	20.42	20.37	19.97	19.39	18.94	(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	0.84	0.64	0.43	0.3	0.37	0.66	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	430.43	503.52	595.15	659.07	587.46	408.88	271.02	283.77	419.88	466.08	423.02	408.09	(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=	1071.51	1042.66	954.35	806.57	621.24	413.15	271.61	285.16	447.19	672.98	885.79	1067	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	476.97	362.3	267.25	106.21	25.13	0	0	0	0	153.93	333.2	490.22	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2215.21	(98)
Space heating requirement in kWh/m²/year	37.39	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.7	(303a)
Fraction of community heat from heat source 2 (Water)		0.3	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2215.21	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2325.97	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1921.48	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1412.29	(310a)

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Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	605.27	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	23.26	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.18	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		129.3	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	129.3	(331)
Energy for lighting (calculated in Appendix L)		269.31	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-684.44	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	402.39	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	12.07	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	244.33	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	314.13	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	10.47	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	983.4	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				983.4	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	67.11	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	139.77	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-355.23	(380)
Total CO2, kg/year	sum of (376)…(382) =				835.05	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.09	(384)

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EI rating (section 14)	89.27	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	72.85	(1a)	x	2.7	(2a)	=	196.69	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	72.85	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	196.69	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0 ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
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) =	0.12	(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
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

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) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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=	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(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	1.3	=	2.6			(26)
Windows Type 1			7.1	x1/[1/(1.3)+ 0.04]		=	8.77			(27)
Windows Type 2			9.86	x1/[1/(1.3)+ 0.04]		=	12.18			(27)
Windows Type 3			7.48	x1/[1/(1.3)+ 0.04]		=	9.24			(27)
Windows Type 4			1.53	x1/[1/(1.3)+ 0.04]		=	1.89			(27)
Rooflights			1.14	x1/[1/(1.6) + 0.04]		=	1.824			(27b)
Walls Type1	40.58	25.97	14.61	x	0.15	=	2.19			(29)
Walls Type2	56.98	2	54.98	x	0.13	=	7.34			(29)
Roof	72.85	1.14	71.71	x	0.1	=	7.17			(30)
Total area of elements, m²			170.41							(31)
Party wall			23.2	x	0	=	0			(32)
Party floor			72.85							(32a)

** 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) = 53.11 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17245.49 (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 16.31 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 69.42 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17.52	17.33	17.15	16.2	16.01	15.07	15.07	14.88	15.45	16.01	16.39	16.77	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	86.94	86.76	86.57	85.62	85.43	84.49	84.49	84.3	84.87	85.43	85.81	86.19	

Average = $Sum(39)_{1…12}$ /12= 85.58 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.19	1.19	1.19	1.18	1.17	1.16	1.16	1.16	1.16	1.17	1.18	1.18	

Average = $Sum(40)_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.31 (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 89.14 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	98.05	94.49	90.92	87.36	83.79	80.23	80.23	83.79	87.36	90.92	94.49	98.05

Total = $Sum(44)_{1…12}$ = 1069.69 (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=	145.41	127.18	131.24	114.42	109.78	94.74	87.79	100.74	101.94	118.8	129.68	140.82

Total = $Sum(45)_{1…12}$ = 1402.53 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.81	19.08	19.69	17.16	16.47	14.21	13.17	15.11	15.29	17.82	19.45	21.12	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	200.69	177.11	186.51	167.91	165.06	148.23	143.06	156.01	155.43	174.08	183.17	196.1	(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=	200.69	177.11	186.51	167.91	165.06	148.23	143.06	156.01	155.43	174.08	183.17	196.1

Output from water heater (annual)$_{1…12}$ | 2053.37 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	92.57	82.23	87.86	80.84	80.72	74.29	73.41	77.72	76.69	83.72	85.91	91.05	(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=	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	115.66	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.17	16.14	13.13	9.94	7.43	6.27	6.78	8.81	11.82	15.01	17.52	18.68	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	203.86	205.97	200.64	189.29	174.97	161.5	152.51	150.39	155.72	167.07	181.4	194.86	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	34.57	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	-92.53	(71)

Water heating gains (Table 5)

(72)m=	124.42	122.36	118.09	112.27	108.5	103.19	98.67	104.46	106.51	112.53	119.32	122.37	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	404.15	402.18	389.55	369.2	348.6	328.66	315.65	321.36	331.76	352.31	375.94	393.61	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	1.53	x	11.28	x	0.55	x	0.7	=	4.61	(75)
Northeast 0.9x	0.77	x	1.53	x	22.97	x	0.55	x	0.7	=	9.38	(75)
Northeast 0.9x	0.77	x	1.53	x	41.38	x	0.55	x	0.7	=	16.89	(75)
Northeast 0.9x	0.77	x	1.53	x	67.96	x	0.55	x	0.7	=	27.74	(75)
Northeast 0.9x	0.77	x	1.53	x	91.35	x	0.55	x	0.7	=	37.29	(75)
Northeast 0.9x	0.77	x	1.53	x	97.38	x	0.55	x	0.7	=	39.75	(75)
Northeast 0.9x	0.77	x	1.53	x	91.1	x	0.55	x	0.7	=	37.19	(75)
Northeast 0.9x	0.77	x	1.53	x	72.63	x	0.55	x	0.7	=	29.65	(75)
Northeast 0.9x	0.77	x	1.53	x	50.42	x	0.55	x	0.7	=	20.58	(75)
Northeast 0.9x	0.77	x	1.53	x	28.07	x	0.55	x	0.7	=	11.46	(75)
Northeast 0.9x	0.77	x	1.53	x	14.2	x	0.55	x	0.7	=	5.8	(75)
Northeast 0.9x	0.77	x	1.53	x	9.21	x	0.55	x	0.7	=	3.76	(75)
Southeast 0.9x	0.77	x	7.1	x	36.79	x	0.55	x	0.7	=	69.7	(77)
Southeast 0.9x	0.77	x	9.86	x	36.79	x	0.55	x	0.7	=	96.79	(77)
Southeast 0.9x	0.77	x	7.48	x	36.79	x	0.55	x	0.7	=	73.43	(77)
Southeast 0.9x	0.77	x	7.1	x	62.67	x	0.55	x	0.7	=	118.72	(77)
Southeast 0.9x	0.77	x	9.86	x	62.67	x	0.55	x	0.7	=	164.87	(77)
Southeast 0.9x	0.77	x	7.48	x	62.67	x	0.55	x	0.7	=	125.08	(77)
Southeast 0.9x	0.77	x	7.1	x	85.75	x	0.55	x	0.7	=	162.44	(77)
Southeast 0.9x	0.77	x	9.86	x	85.75	x	0.55	x	0.7	=	225.59	(77)
Southeast 0.9x	0.77	x	7.48	x	85.75	x	0.55	x	0.7	=	171.14	(77)
Southeast 0.9x	0.77	x	7.1	x	106.25	x	0.55	x	0.7	=	201.27	(77)
Southeast 0.9x	0.77	x	9.86	x	106.25	x	0.55	x	0.7	=	279.52	(77)
Southeast 0.9x	0.77	x	7.48	x	106.25	x	0.55	x	0.7	=	212.05	(77)
Southeast 0.9x	0.77	x	7.1	x	119.01	x	0.55	x	0.7	=	225.44	(77)
Southeast 0.9x	0.77	x	9.86	x	119.01	x	0.55	x	0.7	=	313.08	(77)
Southeast 0.9x	0.77	x	7.48	x	119.01	x	0.55	x	0.7	=	237.51	(77)
Southeast 0.9x	0.77	x	7.1	x	118.15	x	0.55	x	0.7	=	223.81	(77)
Southeast 0.9x	0.77	x	9.86	x	118.15	x	0.55	x	0.7	=	310.82	(77)
Southeast 0.9x	0.77	x	7.48	x	118.15	x	0.55	x	0.7	=	235.79	(77)
Southeast 0.9x	0.77	x	7.1	x	113.91	x	0.55	x	0.7	=	215.78	(77)
Southeast 0.9x	0.77	x	9.86	x	113.91	x	0.55	x	0.7	=	299.66	(77)
Southeast 0.9x	0.77	x	7.48	x	113.91	x	0.55	x	0.7	=	227.33	(77)
Southeast 0.9x	0.77	x	7.1	x	104.39	x	0.55	x	0.7	=	197.75	(77)
Southeast 0.9x	0.77	x	9.86	x	104.39	x	0.55	x	0.7	=	274.62	(77)
Southeast 0.9x	0.77	x	7.48	x	104.39	x	0.55	x	0.7	=	208.33	(77)
Southeast 0.9x	0.77	x	7.1	x	92.85	x	0.55	x	0.7	=	175.89	(77)
Southeast 0.9x	0.77	x	9.86	x	92.85	x	0.55	x	0.7	=	244.27	(77)
Southeast 0.9x	0.77	x	7.48	x	92.85	x	0.55	x	0.7	=	185.3	(77)

Southeast	0.9x	0.77	x	7.1	x	69.27	x	0.55	x	0.7	=	131.21	(77)
Southeast	0.9x	0.77	x	9.86	x	69.27	x	0.55	x	0.7	=	182.22	(77)
Southeast	0.9x	0.77	x	7.48	x	69.27	x	0.55	x	0.7	=	138.24	(77)
Southeast	0.9x	0.77	x	7.1	x	44.07	x	0.55	x	0.7	=	83.48	(77)
Southeast	0.9x	0.77	x	9.86	x	44.07	x	0.55	x	0.7	=	115.94	(77)
Southeast	0.9x	0.77	x	7.48	x	44.07	x	0.55	x	0.7	=	87.95	(77)
Southeast	0.9x	0.77	x	7.1	x	31.49	x	0.55	x	0.7	=	59.65	(77)
Southeast	0.9x	0.77	x	9.86	x	31.49	x	0.55	x	0.7	=	82.83	(77)
Southeast	0.9x	0.77	x	7.48	x	31.49	x	0.55	x	0.7	=	62.84	(77)
Rooflights	0.9x	1	x	1.14	x	26	x	0.55	x	0.8	=	11.74	(82)
Rooflights	0.9x	1	x	1.14	x	54	x	0.55	x	0.8	=	24.38	(82)
Rooflights	0.9x	1	x	1.14	x	96	x	0.55	x	0.8	=	43.34	(82)
Rooflights	0.9x	1	x	1.14	x	150	x	0.55	x	0.8	=	67.72	(82)
Rooflights	0.9x	1	x	1.14	x	192	x	0.55	x	0.8	=	86.68	(82)
Rooflights	0.9x	1	x	1.14	x	200	x	0.55	x	0.8	=	90.29	(82)
Rooflights	0.9x	1	x	1.14	x	189	x	0.55	x	0.8	=	85.32	(82)
Rooflights	0.9x	1	x	1.14	x	157	x	0.55	x	0.8	=	70.88	(82)
Rooflights	0.9x	1	x	1.14	x	115	x	0.55	x	0.8	=	51.92	(82)
Rooflights	0.9x	1	x	1.14	x	66	x	0.55	x	0.8	=	29.8	(82)
Rooflights	0.9x	1	x	1.14	x	33	x	0.55	x	0.8	=	14.9	(82)
Rooflights	0.9x	1	x	1.14	x	21	x	0.55	x	0.8	=	9.48	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	256.27	442.43	619.4	788.29	900	900.46	865.28	781.22	677.96	492.93	308.06	218.56	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	660.42	844.6	1008.95	1157.5	1248.59	1229.12	1180.93	1102.58	1009.72	845.24	684.01	612.18	(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	0.96	0.91	0.78	0.61	0.44	0.31	0.35	0.56	0.85	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.98	20.25	20.56	20.83	20.96	20.99	21	21	20.98	20.78	20.32	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.93	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.95	0.88	0.74	0.55	0.37	0.24	0.27	0.48	0.81	0.96	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.6	18.99	19.42	19.77	19.91	19.95	19.95	19.95	19.93	19.72	19.1	18.52	(90)

fLA = Living area ÷ (4) = | 0.45 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.22	19.56	19.93	20.24	20.38	20.42	20.42	20.42	20.4	20.2	19.65	19.15	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.22	19.56	19.93	20.24	20.38	20.42	20.42	20.42	20.4	20.2	19.65	19.15	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.95	0.88	0.75	0.57	0.4	0.27	0.31	0.52	0.82	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	648.14	802.43	891.42	869.8	717.4	488.37	322.44	338.35	523.88	692.27	655.44	603.78	(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=	1296.82	1271.7	1162.82	971.38	741.31	491.42	322.8	339	534.78	820.02	1076.86	1288.54	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	482.62	315.35	201.93	73.13	17.79	0	0	0	0	95.05	303.42	509.46	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1998.75	(98)
Space heating requirement in kWh/m²/year	27.44	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.7	(303a)
Fraction of community heat from heat source 2 (Water)		0.3	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1998.75	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2098.69	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2053.37	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1509.22	(310a)

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Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	646.81	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.99	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.56	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.98	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	158.98	(331)
Energy for lighting (calculated in Appendix L)		320.96	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-684.44	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	363.07	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	10.89	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	261.1	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	335.69	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.19	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	981.95	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				981.95	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	82.51	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	166.58	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-355.23	(380)
Total CO2, kg/year	sum of (376)…(382) =				875.81	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.02	(384)

DER WorkSheet: New dwelling design stage

EI rating (section 14)	90.04	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61.4	(1a) x	2.7	(2a) =	165.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61.4	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		165.78	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.13	(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
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

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

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) = 75.65 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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=	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	1.3	=	2.6			(26)
Windows Type 1			3.7	x1/[1/(1.3)+ 0.04]		=	4.57			(27)
Windows Type 2			0.91	x1/[1/(1.3)+ 0.04]		=	1.12			(27)
Windows Type 3			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Windows Type 4			8.37	x1/[1/(1.3)+ 0.04]		=	10.34			(27)
Windows Type 5			6.29	x1/[1/(1.3)+ 0.04]		=	7.77			(27)
Walls Type1	51.43	29.26	22.17	x	0.15	=	3.33			(29)
Walls Type2	35.95	2	33.95	x	0.13	=	4.53			(29)
Roof	61.4	0	61.4	x	0.1	=	6.14			(30)
Total area of elements, m²			148.78							(31)
Party wall			17.92	x	0	=	0			(32)
Party floor			61.4							(32a)

** 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) = 52.76 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14029.8 (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 15.8 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

DER WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	68.55	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	15.55	15.38	15.21	14.33	14.16	13.29	13.29	13.11	13.64	14.16	14.51	14.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	84.11	83.93	83.76	82.89	82.71	81.84	81.84	81.67	82.19	82.71	83.06	83.41	

Average = $Sum(39)_{1...12}$ /12= 82.84 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.37	1.37	1.36	1.35	1.35	1.33	1.33	1.33	1.34	1.35	1.35	1.36	

Average = $Sum(40)_{1...12}$ /12= 1.35 (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 2.02 (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 82.2 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	90.42	87.13	83.84	80.55	77.27	73.98	73.98	77.27	80.55	83.84	87.13	90.42	

Total = $Sum(44)_{1...12}$ = 986.36 (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=	134.09	117.27	121.01	105.5	101.23	87.36	80.95	92.89	94	109.55	119.58	129.85	

Total = $Sum(45)_{1...12}$ = 1293.28 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	20.11	17.59	18.15	15.83	15.18	13.1	12.14	13.93	14.1	16.43	17.94	19.48	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)
If community heating and no tank in dwelling, enter 110 litres in (47)			
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)			
Water storage loss:			
a) If manufacturer’s declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)
b) If manufacturer’s declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)
If community heating see section 4.3			
Volume factor from Table 2a		1.03	(52)
Temperature factor from Table 2b		0.6	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

DER WorkSheet: New dwelling design stage

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 | 0 | (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	189.36	167.2	176.29	159	156.51	140.85	136.23	148.17	147.49	164.82	173.07	185.13	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	189.36	167.2	176.29	159	156.51	140.85	136.23	148.17	147.49	164.82	173.07	185.13

Output from water heater (annual)$_{1...12}$ | 1944.12 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	88.8	78.93	84.46	77.87	77.88	71.84	71.14	75.11	74.05	80.65	82.55	87.4	(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=	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	101.05	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	15.73	13.97	11.36	8.6	6.43	5.43	5.87	7.63	10.23	13	15.17	16.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	176.46	178.29	173.68	163.86	151.46	139.8	132.02	130.18	134.8	144.62	157.02	168.68	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	-80.84	(71)

Water heating gains (Table 5)

(72)m=	119.36	117.46	113.52	108.16	104.68	99.78	95.61	100.95	102.85	108.39	114.66	117.47	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	364.87	363.04	351.88	333.93	315.88	298.32	286.81	292.07	301.19	319.33	340.16	355.63	(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 m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southwest	0.9x	0.77	x	8.37	x	36.79		0.55	x	0.7	=	82.17	(79)
Southwest	0.9x	0.77	x	6.29	x	36.79		0.55	x	0.7	=	61.75	(79)
Southwest	0.9x	0.77	x	8.37	x	62.67		0.55	x	0.7	=	139.96	(79)
Southwest	0.9x	0.77	x	6.29	x	62.67		0.55	x	0.7	=	105.18	(79)
Southwest	0.9x	0.77	x	8.37	x	85.75		0.55	x	0.7	=	191.5	(79)
Southwest	0.9x	0.77	x	6.29	x	85.75		0.55	x	0.7	=	143.91	(79)
Southwest	0.9x	0.77	x	8.37	x	106.25		0.55	x	0.7	=	237.28	(79)
Southwest	0.9x	0.77	x	6.29	x	106.25		0.55	x	0.7	=	178.31	(79)
Southwest	0.9x	0.77	x	8.37	x	119.01		0.55	x	0.7	=	265.77	(79)
Southwest	0.9x	0.77	x	6.29	x	119.01		0.55	x	0.7	=	199.72	(79)
Southwest	0.9x	0.77	x	8.37	x	118.15		0.55	x	0.7	=	263.85	(79)
Southwest	0.9x	0.77	x	6.29	x	118.15		0.55	x	0.7	=	198.28	(79)
Southwest	0.9x	0.77	x	8.37	x	113.91		0.55	x	0.7	=	254.38	(79)
Southwest	0.9x	0.77	x	6.29	x	113.91		0.55	x	0.7	=	191.16	(79)
Southwest	0.9x	0.77	x	8.37	x	104.39		0.55	x	0.7	=	233.12	(79)
Southwest	0.9x	0.77	x	6.29	x	104.39		0.55	x	0.7	=	175.19	(79)
Southwest	0.9x	0.77	x	8.37	x	92.85		0.55	x	0.7	=	207.35	(79)
Southwest	0.9x	0.77	x	6.29	x	92.85		0.55	x	0.7	=	155.82	(79)
Southwest	0.9x	0.77	x	8.37	x	69.27		0.55	x	0.7	=	154.69	(79)
Southwest	0.9x	0.77	x	6.29	x	69.27		0.55	x	0.7	=	116.25	(79)
Southwest	0.9x	0.77	x	8.37	x	44.07		0.55	x	0.7	=	98.42	(79)
Southwest	0.9x	0.77	x	6.29	x	44.07		0.55	x	0.7	=	73.96	(79)
Southwest	0.9x	0.77	x	8.37	x	31.49		0.55	x	0.7	=	70.32	(79)
Southwest	0.9x	0.77	x	6.29	x	31.49		0.55	x	0.7	=	52.84	(79)
Northwest	0.9x	0.77	x	3.7	x	11.28	x	0.55	x	0.7	=	22.28	(81)
Northwest	0.9x	0.77	x	0.91	x	11.28	x	0.55	x	0.7	=	2.74	(81)
Northwest	0.9x	0.77	x	6.29	x	11.28	x	0.55	x	0.7	=	18.94	(81)
Northwest	0.9x	0.77	x	3.7	x	22.97	x	0.55	x	0.7	=	45.34	(81)
Northwest	0.9x	0.77	x	0.91	x	22.97	x	0.55	x	0.7	=	5.58	(81)
Northwest	0.9x	0.77	x	6.29	x	22.97	x	0.55	x	0.7	=	38.54	(81)
Northwest	0.9x	0.77	x	3.7	x	41.38	x	0.55	x	0.7	=	81.7	(81)
Northwest	0.9x	0.77	x	0.91	x	41.38	x	0.55	x	0.7	=	10.05	(81)
Northwest	0.9x	0.77	x	6.29	x	41.38	x	0.55	x	0.7	=	69.44	(81)
Northwest	0.9x	0.77	x	3.7	x	67.96	x	0.55	x	0.7	=	134.17	(81)
Northwest	0.9x	0.77	x	0.91	x	67.96	x	0.55	x	0.7	=	16.5	(81)
Northwest	0.9x	0.77	x	6.29	x	67.96	x	0.55	x	0.7	=	114.04	(81)
Northwest	0.9x	0.77	x	3.7	x	91.35	x	0.55	x	0.7	=	180.35	(81)
Northwest	0.9x	0.77	x	0.91	x	91.35	x	0.55	x	0.7	=	22.18	(81)
Northwest	0.9x	0.77	x	6.29	x	91.35	x	0.55	x	0.7	=	153.3	(81)

Northwest	0.9x	0.77	x	3.7	x	97.38	x	0.55	x	0.7	=	192.27	(81)
Northwest	0.9x	0.77	x	0.91	x	97.38	x	0.55	x	0.7	=	23.64	(81)
Northwest	0.9x	0.77	x	6.29	x	97.38	x	0.55	x	0.7	=	163.43	(81)
Northwest	0.9x	0.77	x	3.7	x	91.1	x	0.55	x	0.7	=	179.87	(81)
Northwest	0.9x	0.77	x	0.91	x	91.1	x	0.55	x	0.7	=	22.12	(81)
Northwest	0.9x	0.77	x	6.29	x	91.1	x	0.55	x	0.7	=	152.89	(81)
Northwest	0.9x	0.77	x	3.7	x	72.63	x	0.55	x	0.7	=	143.39	(81)
Northwest	0.9x	0.77	x	0.91	x	72.63	x	0.55	x	0.7	=	17.63	(81)
Northwest	0.9x	0.77	x	6.29	x	72.63	x	0.55	x	0.7	=	121.88	(81)
Northwest	0.9x	0.77	x	3.7	x	50.42	x	0.55	x	0.7	=	99.55	(81)
Northwest	0.9x	0.77	x	0.91	x	50.42	x	0.55	x	0.7	=	12.24	(81)
Northwest	0.9x	0.77	x	6.29	x	50.42	x	0.55	x	0.7	=	84.62	(81)
Northwest	0.9x	0.77	x	3.7	x	28.07	x	0.55	x	0.7	=	55.41	(81)
Northwest	0.9x	0.77	x	0.91	x	28.07	x	0.55	x	0.7	=	6.81	(81)
Northwest	0.9x	0.77	x	6.29	x	28.07	x	0.55	x	0.7	=	47.1	(81)
Northwest	0.9x	0.77	x	3.7	x	14.2	x	0.55	x	0.7	=	28.03	(81)
Northwest	0.9x	0.77	x	0.91	x	14.2	x	0.55	x	0.7	=	3.45	(81)
Northwest	0.9x	0.77	x	6.29	x	14.2	x	0.55	x	0.7	=	23.83	(81)
Northwest	0.9x	0.77	x	3.7	x	9.21	x	0.55	x	0.7	=	18.19	(81)
Northwest	0.9x	0.77	x	0.91	x	9.21	x	0.55	x	0.7	=	2.24	(81)
Northwest	0.9x	0.77	x	6.29	x	9.21	x	0.55	x	0.7	=	15.46	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	187.86	334.6	496.59	680.3	821.32	841.47	800.41	691.22	559.58	380.26	227.68	159.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	552.74	697.65	848.47	1014.23	1137.2	1139.8	1087.22	983.29	860.78	699.59	567.84	514.68	(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	0.93	0.81	0.63	0.45	0.33	0.38	0.62	0.89	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	20.01	20.37	20.73	20.93	20.99	21	21	20.95	20.65	20.12	19.69	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.79	19.79	19.79	19.8	19.8	19.82	19.82	19.82	19.81	19.8	19.8	19.8	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.91	0.77	0.56	0.37	0.24	0.28	0.53	0.85	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.16	18.55	19.05	19.53	19.74	19.81	19.81	19.82	19.78	19.44	18.71	18.09	(90)

fLA = Living area ÷ (4) = | 0.5 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.94	19.27	19.71	20.13	20.33	20.39	20.4	20.4	20.36	20.04	19.41	18.88	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.94	19.27	19.71	20.13	20.33	20.39	20.4	20.4	20.36	20.04	19.41	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=	0.98	0.96	0.9	0.78	0.6	0.41	0.29	0.33	0.57	0.86	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	543.49	669.56	767.46	790.22	677.4	468.72	310.44	325.33	492.43	600.24	548.3	508.09	(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=	1231.64	1206.5	1106.16	930.68	714.01	474.25	311.26	326.91	514.66	781.02	1022.45	1224.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	511.98	360.82	251.99	101.13	27.24	0	0	0	0	134.51	341.39	533.23	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2262.29	(98)
Space heating requirement in kWh/m²/year	36.85	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.7	(303a)
Fraction of community heat from heat source 2 (Water)		0.3	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2262.29	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2375.4	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1944.12	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1428.93	(310a)

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Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	612.4	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	23.75	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	20.41	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		133.99	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	133.99	(331)
Energy for lighting (calculated in Appendix L)		277.83	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-684.44	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO_2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	410.94	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	12.33	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	247.2	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	317.83	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	10.59	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	998.91	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				998.91	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	69.54	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	144.19	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =		-355.23	(380)
Total CO2, kg/year	sum of (376)…(382) =				857.41	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				13.96	(384)

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EI rating (section 14)	89.2	(385)

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.16

Property Address: Apartment 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.4	(1a) x	2.7	(2a) =	203.58	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	203.58	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

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) =	0.14	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	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) = 74.8 (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	0.25	0.26	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	0.25	0.26	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	x	1.3	=	2.6			(26)
Windows Type 1			1.27	x1/[1/(1.3)+ 0.04]		=	1.57			(27)
Windows Type 2			2.7	x1/[1/(1.3)+ 0.04]		=	3.34			(27)
Windows Type 3			2.22	x1/[1/(1.3)+ 0.04]		=	2.74			(27)
Windows Type 4			2.78	x1/[1/(1.3)+ 0.04]		=	3.44			(27)
Windows Type 5			7.75	x1/[1/(1.3)+ 0.04]		=	9.58			(27)
Windows Type 6			1.19	x1/[1/(1.3)+ 0.04]		=	1.47			(27)
Windows Type 7			2	x1/[1/(1.3)+ 0.04]		=	2.47			(27)
Rooflights			1.05	x1/[1/(1.6) + 0.04]		=	1.68			(27b)
Walls Type1	68.45	21.91	46.54	x	0.15	=	6.98			(29)
Walls Type2	4.03	2	2.03	x	0.13	=	0.27			(29)
Roof	75.4	1.05	74.35	x	0.1	=	7.44			(30)
Total area of elements, m²			147.88							(31)
Party wall			42.95	x	0	=	0			(32)
Party floor			75.4							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.94 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13772.45 (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 | 17.49 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 63.43 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	20.35	20.12	19.88	18.72	18.49	17.32	17.32	17.09	17.79	18.49	18.95	19.42	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	83.78	83.55	83.32	82.15	81.92	80.75	80.75	80.52	81.22	81.92	82.38	82.85	

Average = Sum(39)$_{1…12}$ /12= | 82.09 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1	

Average = Sum(40)$_{1…12}$ /12= | 1.09 | (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 | 2.37 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 90.48 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	99.53	95.91	92.29	88.67	85.05	81.43	81.43	85.05	88.67	92.29	95.91	99.53	

Total = Sum(44)$_{1…12}$ = | 1085.79 | (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=	147.6	129.09	133.21	116.14	111.44	96.16	89.11	102.25	103.47	120.59	131.63	142.94	

Total = Sum(45)$_{1…12}$ = | 1423.64 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.14	19.36	19.98	17.42	16.72	14.42	13.37	15.34	15.52	18.09	19.74	21.44	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 110 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.02 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 1.03 | (52)

Temperature factor from Table 2b | 0.6 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)		1.03	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 — 0 — (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	202.88	179.02	188.49	169.63	166.71	149.66	144.38	157.53	156.97	175.87	185.13	198.22	(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=	202.88	179.02	188.49	169.63	166.71	149.66	144.38	157.53	156.97	175.87	185.13	198.22	

Output from water heater (annual)$_{1\ldots12}$ — 2074.48 — (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	93.3	82.87	88.51	81.41	81.27	74.77	73.85	78.22	77.2	84.32	86.56	91.75	(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=	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	118.49	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.68	16.59	13.49	10.22	7.64	6.45	6.97	9.06	12.15	15.43	18.01	19.2	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	209.56	211.73	206.25	194.59	179.86	166.02	156.78	154.6	160.08	171.75	186.47	200.31	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	34.85	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	-94.79	(71)
Water heating gains (Table 5)													
(72)m=	125.4	123.31	118.97	113.07	109.24	103.85	99.26	105.14	107.22	113.33	120.23	123.32	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	412.19	410.19	397.27	376.42	355.29	334.86	321.55	327.34	338	359.06	383.26	401.38	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	7.75	x	11.28	x	0.55	x	0.7	=	23.33	(75)
Northeast	0.9x	0.77	x	1.19	x	11.28	x	0.55	x	0.7	=	3.58	(75)
Northeast	0.9x	0.77	x	7.75	x	22.97	x	0.55	x	0.7	=	47.49	(75)
Northeast	0.9x	0.77	x	1.19	x	22.97	x	0.55	x	0.7	=	7.29	(75)
Northeast	0.9x	0.77	x	7.75	x	41.38	x	0.55	x	0.7	=	85.56	(75)
Northeast	0.9x	0.77	x	1.19	x	41.38	x	0.55	x	0.7	=	13.14	(75)
Northeast	0.9x	0.77	x	7.75	x	67.96	x	0.55	x	0.7	=	140.51	(75)
Northeast	0.9x	0.77	x	1.19	x	67.96	x	0.55	x	0.7	=	21.58	(75)
Northeast	0.9x	0.77	x	7.75	x	91.35	x	0.55	x	0.7	=	188.88	(75)
Northeast	0.9x	0.77	x	1.19	x	91.35	x	0.55	x	0.7	=	29	(75)
Northeast	0.9x	0.77	x	7.75	x	97.38	x	0.55	x	0.7	=	201.37	(75)
Northeast	0.9x	0.77	x	1.19	x	97.38	x	0.55	x	0.7	=	30.92	(75)
Northeast	0.9x	0.77	x	7.75	x	91.1	x	0.55	x	0.7	=	188.37	(75)
Northeast	0.9x	0.77	x	1.19	x	91.1	x	0.55	x	0.7	=	28.92	(75)
Northeast	0.9x	0.77	x	7.75	x	72.63	x	0.55	x	0.7	=	150.17	(75)
Northeast	0.9x	0.77	x	1.19	x	72.63	x	0.55	x	0.7	=	23.06	(75)
Northeast	0.9x	0.77	x	7.75	x	50.42	x	0.55	x	0.7	=	104.26	(75)
Northeast	0.9x	0.77	x	1.19	x	50.42	x	0.55	x	0.7	=	16.01	(75)
Northeast	0.9x	0.77	x	7.75	x	28.07	x	0.55	x	0.7	=	58.04	(75)
Northeast	0.9x	0.77	x	1.19	x	28.07	x	0.55	x	0.7	=	8.91	(75)
Northeast	0.9x	0.77	x	7.75	x	14.2	x	0.55	x	0.7	=	29.36	(75)
Northeast	0.9x	0.77	x	1.19	x	14.2	x	0.55	x	0.7	=	4.51	(75)
Northeast	0.9x	0.77	x	7.75	x	9.21	x	0.55	x	0.7	=	19.05	(75)
Northeast	0.9x	0.77	x	1.19	x	9.21	x	0.55	x	0.7	=	2.93	(75)
Southeast	0.9x	0.77	x	2	x	36.79	x	0.55	x	0.7	=	39.27	(77)
Southeast	0.9x	0.77	x	2	x	62.67	x	0.55	x	0.7	=	66.89	(77)
Southeast	0.9x	0.77	x	2	x	85.75	x	0.55	x	0.7	=	91.52	(77)
Southeast	0.9x	0.77	x	2	x	106.25	x	0.55	x	0.7	=	113.39	(77)
Southeast	0.9x	0.77	x	2	x	119.01	x	0.55	x	0.7	=	127.01	(77)
Southeast	0.9x	0.77	x	2	x	118.15	x	0.55	x	0.7	=	126.09	(77)
Southeast	0.9x	0.77	x	2	x	113.91	x	0.55	x	0.7	=	121.57	(77)
Southeast	0.9x	0.77	x	2	x	104.39	x	0.55	x	0.7	=	111.41	(77)
Southeast	0.9x	0.77	x	2	x	92.85	x	0.55	x	0.7	=	99.09	(77)
Southeast	0.9x	0.77	x	2	x	69.27	x	0.55	x	0.7	=	73.92	(77)
Southeast	0.9x	0.77	x	2	x	44.07	x	0.55	x	0.7	=	47.03	(77)
Southeast	0.9x	0.77	x	2	x	31.49	x	0.55	x	0.7	=	33.6	(77)
Southwest	0.9x	0.77	x	1.27	x	36.79		0.55	x	0.7	=	12.47	(79)
Southwest	0.9x	0.77	x	2.7	x	36.79		0.55	x	0.7	=	26.51	(79)
Southwest	0.9x	0.77	x	2.22	x	36.79		0.55	x	0.7	=	21.79	(79)

Southwest	0.9x	0.77	x	2.78	x	36.79	0.55	x	0.7	=	27.29	(79)
Southwest	0.9x	0.77	x	1.27	x	62.67	0.55	x	0.7	=	21.24	(79)
Southwest	0.9x	0.77	x	2.7	x	62.67	0.55	x	0.7	=	45.15	(79)
Southwest	0.9x	0.77	x	2.22	x	62.67	0.55	x	0.7	=	37.12	(79)
Southwest	0.9x	0.77	x	2.78	x	62.67	0.55	x	0.7	=	46.49	(79)
Southwest	0.9x	0.77	x	1.27	x	85.75	0.55	x	0.7	=	29.06	(79)
Southwest	0.9x	0.77	x	2.7	x	85.75	0.55	x	0.7	=	61.77	(79)
Southwest	0.9x	0.77	x	2.22	x	85.75	0.55	x	0.7	=	50.79	(79)
Southwest	0.9x	0.77	x	2.78	x	85.75	0.55	x	0.7	=	63.6	(79)
Southwest	0.9x	0.77	x	1.27	x	106.25	0.55	x	0.7	=	36	(79)
Southwest	0.9x	0.77	x	2.7	x	106.25	0.55	x	0.7	=	76.54	(79)
Southwest	0.9x	0.77	x	2.22	x	106.25	0.55	x	0.7	=	62.93	(79)
Southwest	0.9x	0.77	x	2.78	x	106.25	0.55	x	0.7	=	78.81	(79)
Southwest	0.9x	0.77	x	1.27	x	119.01	0.55	x	0.7	=	40.33	(79)
Southwest	0.9x	0.77	x	2.7	x	119.01	0.55	x	0.7	=	85.73	(79)
Southwest	0.9x	0.77	x	2.22	x	119.01	0.55	x	0.7	=	70.49	(79)
Southwest	0.9x	0.77	x	2.78	x	119.01	0.55	x	0.7	=	88.27	(79)
Southwest	0.9x	0.77	x	1.27	x	118.15	0.55	x	0.7	=	40.03	(79)
Southwest	0.9x	0.77	x	2.7	x	118.15	0.55	x	0.7	=	85.11	(79)
Southwest	0.9x	0.77	x	2.22	x	118.15	0.55	x	0.7	=	69.98	(79)
Southwest	0.9x	0.77	x	2.78	x	118.15	0.55	x	0.7	=	87.63	(79)
Southwest	0.9x	0.77	x	1.27	x	113.91	0.55	x	0.7	=	38.6	(79)
Southwest	0.9x	0.77	x	2.7	x	113.91	0.55	x	0.7	=	82.06	(79)
Southwest	0.9x	0.77	x	2.22	x	113.91	0.55	x	0.7	=	67.47	(79)
Southwest	0.9x	0.77	x	2.78	x	113.91	0.55	x	0.7	=	84.49	(79)
Southwest	0.9x	0.77	x	1.27	x	104.39	0.55	x	0.7	=	35.37	(79)
Southwest	0.9x	0.77	x	2.7	x	104.39	0.55	x	0.7	=	75.2	(79)
Southwest	0.9x	0.77	x	2.22	x	104.39	0.55	x	0.7	=	61.83	(79)
Southwest	0.9x	0.77	x	2.78	x	104.39	0.55	x	0.7	=	77.43	(79)
Southwest	0.9x	0.77	x	1.27	x	92.85	0.55	x	0.7	=	31.46	(79)
Southwest	0.9x	0.77	x	2.7	x	92.85	0.55	x	0.7	=	66.89	(79)
Southwest	0.9x	0.77	x	2.22	x	92.85	0.55	x	0.7	=	55	(79)
Southwest	0.9x	0.77	x	2.78	x	92.85	0.55	x	0.7	=	68.87	(79)
Southwest	0.9x	0.77	x	1.27	x	69.27	0.55	x	0.7	=	23.47	(79)
Southwest	0.9x	0.77	x	2.7	x	69.27	0.55	x	0.7	=	49.9	(79)
Southwest	0.9x	0.77	x	2.22	x	69.27	0.55	x	0.7	=	41.03	(79)
Southwest	0.9x	0.77	x	2.78	x	69.27	0.55	x	0.7	=	51.38	(79)
Southwest	0.9x	0.77	x	1.27	x	44.07	0.55	x	0.7	=	14.93	(79)
Southwest	0.9x	0.77	x	2.7	x	44.07	0.55	x	0.7	=	31.75	(79)
Southwest	0.9x	0.77	x	2.22	x	44.07	0.55	x	0.7	=	26.1	(79)
Southwest	0.9x	0.77	x	2.78	x	44.07	0.55	x	0.7	=	32.69	(79)

Southwest 0.9x	0.77	x	1.27	x	31.49		0.55	x	0.7	=	10.67	(79)
Southwest 0.9x	0.77	x	2.7	x	31.49		0.55	x	0.7	=	22.68	(79)
Southwest 0.9x	0.77	x	2.22	x	31.49		0.55	x	0.7	=	18.65	(79)
Southwest 0.9x	0.77	x	2.78	x	31.49		0.55	x	0.7	=	23.36	(79)
Rooflights 0.9x	1	x	1.05	x	26	x	0.55	x	0.8	=	10.81	(82)
Rooflights 0.9x	1	x	1.05	x	54	x	0.55	x	0.8	=	22.45	(82)
Rooflights 0.9x	1	x	1.05	x	96	x	0.55	x	0.8	=	39.92	(82)
Rooflights 0.9x	1	x	1.05	x	150	x	0.55	x	0.8	=	62.37	(82)
Rooflights 0.9x	1	x	1.05	x	192	x	0.55	x	0.8	=	79.83	(82)
Rooflights 0.9x	1	x	1.05	x	200	x	0.55	x	0.8	=	83.16	(82)
Rooflights 0.9x	1	x	1.05	x	189	x	0.55	x	0.8	=	78.59	(82)
Rooflights 0.9x	1	x	1.05	x	157	x	0.55	x	0.8	=	65.28	(82)
Rooflights 0.9x	1	x	1.05	x	115	x	0.55	x	0.8	=	47.82	(82)
Rooflights 0.9x	1	x	1.05	x	66	x	0.55	x	0.8	=	27.44	(82)
Rooflights 0.9x	1	x	1.05	x	33	x	0.55	x	0.8	=	13.72	(82)
Rooflights 0.9x	1	x	1.05	x	21	x	0.55	x	0.8	=	8.73	(82)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	165.05	294.11	435.36	592.14	709.55	724.3	690.06	599.75	489.39	334.09	200.09	139.67	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	577.24	704.3	832.63	968.56	1064.83	1059.16	1011.61	927.09	827.4	693.14	583.35	541.05	(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	0.95	0.85	0.68	0.48	0.35	0.4	0.65	0.91	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.18	20.48	20.79	20.95	20.99	21	21	20.97	20.72	20.28	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	19.99	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.81	0.62	0.41	0.27	0.31	0.57	0.88	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.63	18.94	19.36	19.78	19.97	20.02	20.02	20.03	20	19.72	19.1	18.58	(90)

fLA = Living area ÷ (4) = | 0.35 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.1	19.38	19.76	20.14	20.31	20.37	20.37	20.37	20.34	20.07	19.52	19.06	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.1	19.38	19.76	20.14	20.31	20.37	20.37	20.37	20.34	20.07	19.52	19.06	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.93	0.82	0.63	0.44	0.3	0.34	0.59	0.88	0.98	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	571.25	685.78	775.38	793.39	676.08	462.27	304.09	319.04	491.63	612.57	569.72	536.86	(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=	1240.2	1209.93	1104.51	923.15	705.65	465.57	304.45	319.76	506.99	776.11	1023.21	1231.09	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	497.7	352.23	244.87	93.42	22	0	0	0	0	121.67	326.52	516.51

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2174.92 (98)

Space heating requirement in kWh/m²/year 28.85 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of heat from Community heat pump (Water)		0.7	(303a)
Fraction of community heat from heat source 2 (Water)		0.3	(303b)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Distribution loss factor (Table 12c) for community heating system (Water)		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2174.92	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2283.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2074.48	
If DHW from community scheme: Water heat from CHP (Water)	(64) x (303a) x (305) x (306) =	1524.75	(310a)
Water heat from heat source 2 (Water)	(64) x (303a) x (305) x (306) =	653.46	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	22.84	(313)
Electricity used for heat distribution (Water)	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.78	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):					
mechanical ventilation - balanced, extract or positive input from outside				186.28	(330a)
warm air heating system fans				0	(330b)
pump for solar water heating				0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =			186.28	(331)
Energy for lighting (calculated in Appendix L)				329.94	(332)
Electricity generated by PVs (Appendix M) (negative quantity)				-684.44	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)				0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	395.07	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	11.85	(372)
Water heating from separate community system						
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				300	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				100	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	263.78	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	339.15	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	11.3	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)			=	1021.16	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1021.16	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	96.68	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	171.24	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1		0.52		x 0.01 =	-355.23	(380)
Total CO2, kg/year	sum of (376)...(382) =				933.85	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.39	(384)
EI rating (section 14)					89.61	(385)