ADDENDUM TO THE ENERGY STATEMENT

REPORT NOTES

DATE	PROJECT NAME	PREPARED BY
30/11/2017	Arthur Stanley House	Paolo Balice

NOTES: Addendum to be read in conjunction with the Energy Statement issued on the 20/07/2017 by SRA.

EXECUTIVE SUMMURY

An Addendum to the existing Energy Statement has been prepared for the residential part of the development at Arthur Stanley House; this establishes how it will achieve compliance with the Building Regulation requirements as illustrated in the Approved Document L1A (ADL1A) and with local authority requirements as set in the New Camden Local Plan 2017. This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems); and be green (use of low or zero carbon technologies). It has been assessed that the development will comply with the Building Regulations requirements in terms of carbon emissions achieving a 16.5% improvement over a Part L 2013 compliant building. This result does not meet the local authority target sets out at 19% improvement trigging a carbon offset payment of £720. Moreover, for the apartments not provided with comfort cooling, an overheating assessment based on the Technical Memorandum issued by CIBSE has been carried out showing that these areas will not be prone to overheating during summer.

PROJECT DESCRIPTION

The existing site consists of a vacant former hospital building which will be refurbished for commercial and residential uses with a rear extension added. The proposal will involve the redevelopment and refurbishment of Arthur Stanley House to include flexible office spaces alongside ten private dwellings of which two will be affordable (duplex on lower and ground floor) and the remaining eight will be privately sold. The proposed scheme seeks to:

1) Refurbish the existing building; 2) Extend the floorplates to the rear of the building; 3) Create a high quality environment suitable for Fitzrovia occupiers over small floorplates ranging from approximately 3,200 to 6,400 square feet; 4) Develop a residential block on the Mews with warehouse aesthetics and loft style flats.

BUILDING REGUALTION BACKGROUND

The new residential development will need to follow the prescriptions illustrated in the Approved Document L1A – Conservation of Fuel and Power and in particular it will need to comply with the three criteria:

1. Carbon emissions

The headline emissions target is achieved using the DER/TER figures. CO_2 emissions are measured by comparing a Target Emission Rate (TER) against the predicted Dwelling Emission Rate (DER). This target rate is set within SAP by reference to a notional dwelling of the same size and shape, using a set of baseline values.

2. Fabric Energy Efficiency

Homes built after April 2014 in England are also assessed on Fabric Energy Efficiency. This is not a measure of carbon, but energy demand in units of kilowatt-hours per m^2 per year. Fabric Energy Efficiency is assessed using DFEE/TFEE figures. As with emissions the target is set within SAP using a set of baseline values depending on the size of the property.

3. Limiting heat gains during summer

Heat gains should be limited as much as possible during summer months as they make the spaces prone to overheating and therefore uncomfortable for theirs occupants. The SAP calculation methodology, by which compliance under PartL1A is assessed, also gives an estimate of the likelihood of overheating risk within the dwellings. Besides having a high level of passive design features which will minimise the heat gains, the privately sold apartments in the development will be provided with comfort cooling as well effectively nullifying the risk of overheating. The two affordable duplex have been assessed against the higher standard of overheating risk assessment CIBSE TM52 and TM59 which shows that the apartments are complaint and therefore their occupants will experience thermal comfort.

In addition to the requirements set out in ADL1A, the development is located in the London Borough of Camden which requires further improvements over the standard Building Regulations.

In July 2017 the Borough has issued and adopted a new Local Plan where energy and carbon reduction targets are illustrated. In particular, Policy CC1 - Climate change mitigation sets out that *"the Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation".* The council follows the London Plan Energy Hierarchy (be lean, be clean, be green) to achieve the carbon emissions reduction targets. Paragraph 8.8 of the Camden Local Plan states that "*all developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floor space will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO_2 reduction. All new residential development will also be required to demonstrate a 19% CO_2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy)".*

In light of this policy, the development is targeting the maximum possible achievable carbon emission reduction considering that physical constrains such as limited roof space will make difficult to use of PV panels.

The Standard Assessment Procedure (SAP) is the Government's recommended system for the energy rating of residential dwellings. It is a tool which enables energy assessors to calculate the energy demand and the CO2 emissions of a dwelling. The energy demand calculated using the SAP methodology is relative to the Regulated Emissions which include the energy consumed to power space heating, domestic hot water, ventilation and internal lighting systems. The unregulated emissions (i.e. cooking and appliances) are calculated using BREDEM (BRE Domestic Energy Model). For the purposes of this strategy, a SAP assessment was carried out on each dwelling type present within the development in order to identify each dwelling's potential CO_2 emissions.

Baseline scenario (Part L1A compliant development)

The baseline scenario assumes the minimum values required to meet Building Regulation 2013 Part L1A. This scenario includes all insulation levels, ventilation and building services which are set at the minimum to comply with Approved Document Part L1A and the Domestic Building Services Compliance Guide 2013. The modelling undertaken identified the total CO_2 emissions across the site as 16,070 $kgCO_2$/year.

Be Lean

Energy demand reduction within the building can be utilised to improve compliance with Part L 2013. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building. To reduce the CO_2 emissions of the development it is important to minimise the heat losses through the building fabric. In order to achieve this, U-values for all building fabric elements and openings have been specified to exceed the levels required by Building Regulations. In addition, heat losses from infiltration have been minimised and a low air permeability target has been set. The details of these measures are summarised in the table below.

Thermal Elements	U-value [W/m²K]
External Wall – Unheated spaces	0.15
Ground floor – Exposed Floor	0.11
Roof	0.15
Windows - Doors	1.2 (G value 0.24)
Air permeability	3 m^3/hm^2
Thermal Bridging	Accredited Construction Details

Table 1 – Proposed U values

In addition to upgrading the insulation standards, it is important that the energy used within the building is efficient. To achieve this, energy efficient heating services have been specified with a very efficient heating control system (time and temperature zone control). Also, a high efficient split system (EER 3.5 class A) has been selected for the dwellings provided with comfort cooling.

The air quality within a dwelling is significantly influenced by the ventilation system specified. To ensure high air quality within the dwelling(s), an efficient centralised whole house extract system has been specified, with low specific fan power. Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting across the development has been specified.

The modelling undertaken identified that total site wide carbon dioxide emissions, after the inclusion of improved fabric and building systems (i.e. lean measures) are estimated as 15,430 $kgCO_2$/yr. This is a reduction of 600 $kgCO_2$/year compared to the baseline scenario, which equates a saving of 3.98% on regulated emissions.

Be Clean

Please refer to the Energy Statement issued by SRE on the 20th of July 2017 for the district heating feasibility study.

A gas fired CHP system was deemed to be feasible for the whole development which includes also various use offices. Within the development, the long operating hours required by the CHP will be ensured by the hot water demand, which will be constant throughout the year. As a result, the installation of a gas CHP plant to meet the heat demands year round was investigated and it was assessed that the best strategy to provide the residential part of the development with heating and DHW is the use of a gas fired CHP coupled with a gas fired boiler.

The modelling undertaken identified that total site wide carbon dioxide emissions, after the inclusion of a CHP system are estimated as 14,280 $kgCO_2$/yr. This is a reduction of 1,200 $kgCO_2$/year compared to the "be lean" scenario, which equates to a saving of 7.16%.

Be Green

This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme. The London Plan, which the London Borough of Camden comes under, aspires that all major developments reduce their carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation, where feasible. After taking into consideration a number of different factors, including local authority requirements, land use, potential noise impacts and available space within the development it was concluded that the best strategy for this development is the installation of 2.7 kWp (in total) of photovoltaic panels. These need to be located on the roof of each building, at 30°, facing south. Upon consideration of the LZC technology, the modelling identifies that a further reduction of circa 900 $kgCO_2$/year has been achieved for the carbon emissions taking the overall regulated emissions for the development at 13,420 $KgCO_2$/year. This means that a reduction of 5.35 % has been achieved when compared to the "be clean" scenario.

Results

As requested by the Greater London Authority guidance on preparing energy assessments, the following tables and graphs illustrate the results of the SAP assessment.

Feature	U-value [W/m²K]
Mechanical Ventilation with heat recovery	1 wet zone flat - SFP of 0.42, 90% efficiency; 2 wet zones flat - SFP of 0.54, 90% efficiency
Heating and DHW System	CHP η_{heat}=0.63; η_{elec}=0.306: Gas boilers η=0.96
Cooling System	A class and EER 3.5
Lighting	100% high efficiency fittings
LZC technologies	2.7kWp Monocrystalline panels

Table 2 HVAC system main featured

	Carbon Dioxide Emissions (Tonnes CO2 per annum)		
	Regulated	Unregulated	Total
Baseline: Building regulations 2013 Part L Compliant Development	16.07	10.87	26.94
After energy demand reduction	15.43	10.87	26.30
After CHP	14.28	10.87	25.15
After Renewable energy	13.42	10.87	24.29

Table 3 Energy Hierarchy Carbon Emissions

	Regulated Carbon Dioxide savings	
	[Tonnes CO2 per annum]	[%]
Savings from energy demand reduction	0.64	3.98%
Savings from CHP	1.15	7.16%
Savings from renewable energy	0.86	5.35%
Total cumulative savings	**2.65**	16.49%

	Annual Shortfall [Tonnes CO2]	Cumulative shortfall [Tonnes CO2]
Total target savings	**3.05**	
Shortfall	0.40	12.0

Table 4 Energy Hierarchy Carbon Savings

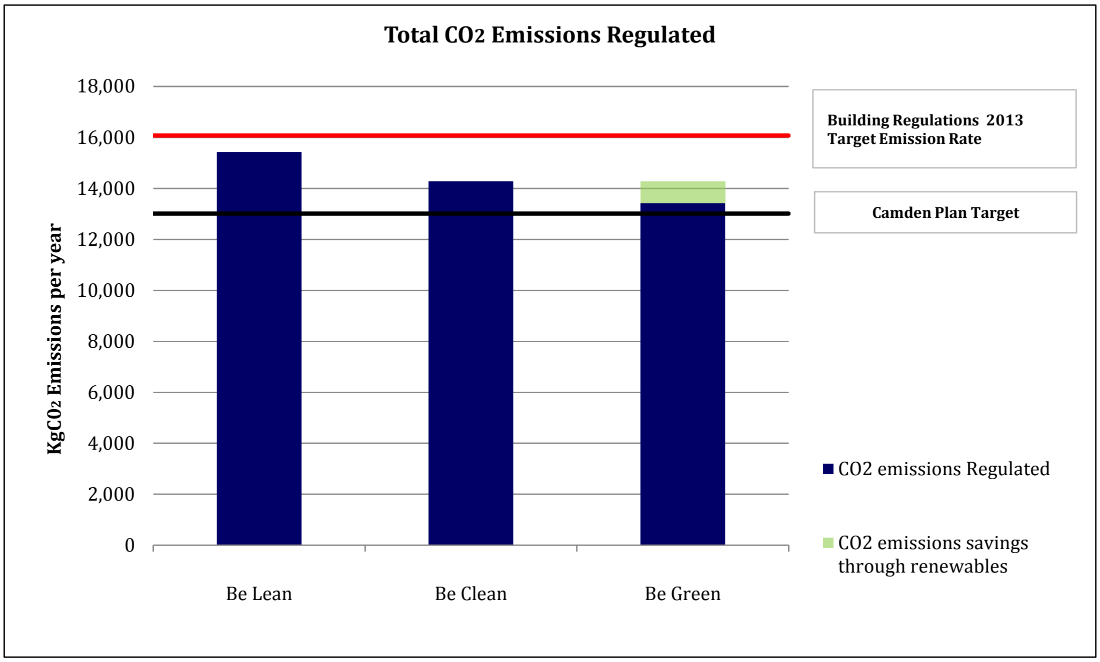

Figure 1 Carbon Emissions Targets

As illustrated above, the development fails to achieve the 19% target improvement over PartL2013 and the shortfall equates to 400 KgCO_2/year. Considering a carbon offset payment of £1,800 per ton this will equate to final payment of £720. However the New Camden Local Plan issued in July 2017 does not contain any figures in terms of carbon offset payment so the previous figure of £1,800 per ton of carbon has been used for the calculation of the carbon off-set payment.

OVERHEATING ASSESSEMENT

The duplex apartments located on the basement and ground floor will not be provided with comfort cooling therefore to design out the overheating risk for those areas, a dynamic simulation approach was used to assess whether the dwellings will be prone to overheating. The dwellings have been assessed against the guidelines contained in CIBSE TM59. This is a standardised approach to predict overheating risk for residential building designs using dynamic thermal analysis. The document provides some guidelines to standardise this type of studies and create a consistent approach which can be used across the industry. The bases of CIBSE TM59 are still rooted in the adaptive thermal comfort framework developed in CIBSE TM52 and in CIBSE Guide A which includes advice regarding sleeping quality in terms of bedroom operative temperature.

As illustrated in the results contained in APPENDIX B, the areas assessed will not be prone to overheating during summer months.

CONCLUSIONS

As shown in the previous paragraphs, the development has targeted the maximum level of carbon emissions reduction achievable. The development will achieve a 16.5% reduction over the target emission rate with a shortfall of 400 $KgCO_2$/year; this will equate to an offset payment of £720 (based on the previously used figure for Camden Borough of £1,800 Tons of CO_2). Moreover, an overheating analysis was carried out for the duplex apartments which showed that these areas will not be prone to overheating during summer months.

APPENDIX A – SAP CALCULATIONS

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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							4	x 10 =	40	(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) =	40	÷ (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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(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

TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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=	0.59	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			10.39	x1/[1/(1.4)+ 0.04]		=	13.77			(27)
Windows Type 2			2.1	x1/[1/(1.4)+ 0.04]		=	2.78			(27)
Windows Type 3			3.2	x1/[1/(1.4)+ 0.04]		=	4.24			(27)
Windows Type 4			5.8	x1/[1/(1.4)+ 0.04]		=	7.69			(27)
Windows Type 5			2.7	x1/[1/(1.4)+ 0.04]		=	3.58			(27)
Floor Type 1			43.25	x	0.13	=	5.6225			(28)
Floor Type 2			31.9	x	0.13	=	4.147			(28)
Walls Type1	77.32	26.79	50.53	x	0.18	=	9.1			(29)
Walls Type2	20.68	0	20.68	x	0.18	=	3.72			(29)
Walls Type3	43.4	0	43.4	x	0.18	=	7.81			(29)
Walls Type4	28.22	0	28.22	x	0.18	=	5.08			(29)
Walls Type5	6.27	0	6.27	x	0.18	=	1.13			(29)
Roof Type1	11.42	0	11.42	x	0.13	=	1.48			(30)
Roof Type2	4.83	0	4.83	x	0.13	=	0.63			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	59.06			(32b)

** 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) =	73.91	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	35629.15	(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		31.54	(36)

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

Total fabric heat loss	(33) + (36) =	105.45	(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=	58.08	57.74	57.42	55.89	55.61	54.27	54.27	54.03	54.79	55.61	56.18	56.79	(38)

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

(39)m=	163.53	163.19	162.87	161.34	161.06	159.72	159.72	159.48	160.24	161.06	161.63	162.24	

Average = $Sum(39)_{1…12}$ /12= 161.34 (39)

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

(40)m=	1.53	1.52	1.52	1.51	1.5	1.49	1.49	1.49	1.5	1.5	1.51	1.51	

Average = $Sum(40)_{1…12}$ /12= 1.51 (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 2.8 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68	

Total = $Sum(44)_{1…12}$ = 1207.41 (44)

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

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96	

Total = $Sum(45)_{1…12}$ = 1583.1 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =		0	(50)
b) If manufacturer's declared cylinder loss factor is not known:				
Hot water storage loss factor from Table 2 (kWh/litre/day)			0	(51)
If community heating see section 4.3				
Volume factor from Table 2a			0	(52)
Temperature factor from Table 2b			0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =		0	(54)
Enter (50) or (54) in (55)			0	(55)

Water storage loss calculated for each month ((56)m = (55) × (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=	50.96	46.03	50.96	48.63	48.2	44.66	46.15	48.2	48.63	50.96	49.32	50.96	(61)

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

(62)m=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91	(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=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91

Output from water heater (annual)$_{1...12}$ | 2166.73 | (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=	67.31	59.24	61.99	55.1	53.25	46.72	44.48	49.86	50.42	57.33	61	65.59	(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=	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	23.84	21.17	17.22	13.04	9.74	8.23	8.89	11.55	15.51	19.69	22.98	24.5	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	267.38	270.16	263.16	248.28	229.49	211.83	200.03	197.26	204.25	219.13	237.92	255.58	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

Water heating gains (Table 5)

(72)m=	90.48	88.15	83.33	76.52	71.58	64.89	59.79	67.01	70.02	77.05	84.72	88.16	(72)

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

(73)m=	449.64	447.43	431.66	405.79	378.76	352.89	336.66	343.77	357.73	383.83	413.57	436.19	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	10.39	x	11.28	x	0.63	x	0.7	=	25.13	(75)
Northeast 0.9x	0.77	x	2.1	x	11.28	x	0.63	x	0.7	=	7.24	(75)
Northeast 0.9x	0.77	x	3.2	x	11.28	x	0.63	x	0.7	=	11.03	(75)
Northeast 0.9x	0.54	x	10.39	x	22.97	x	0.63	x	0.7	=	51.14	(75)
Northeast 0.9x	0.77	x	2.1	x	22.97	x	0.63	x	0.7	=	14.74	(75)
Northeast 0.9x	0.77	x	3.2	x	22.97	x	0.63	x	0.7	=	22.46	(75)
Northeast 0.9x	0.54	x	10.39	x	41.38	x	0.63	x	0.7	=	92.14	(75)
Northeast 0.9x	0.77	x	2.1	x	41.38	x	0.63	x	0.7	=	26.56	(75)
Northeast 0.9x	0.77	x	3.2	x	41.38	x	0.63	x	0.7	=	40.47	(75)
Northeast 0.9x	0.54	x	10.39	x	67.96	x	0.63	x	0.7	=	151.33	(75)
Northeast 0.9x	0.77	x	2.1	x	67.96	x	0.63	x	0.7	=	43.61	(75)
Northeast 0.9x	0.77	x	3.2	x	67.96	x	0.63	x	0.7	=	66.46	(75)
Northeast 0.9x	0.54	x	10.39	x	91.35	x	0.63	x	0.7	=	203.41	(75)
Northeast 0.9x	0.77	x	2.1	x	91.35	x	0.63	x	0.7	=	58.62	(75)
Northeast 0.9x	0.77	x	3.2	x	91.35	x	0.63	x	0.7	=	89.33	(75)
Northeast 0.9x	0.54	x	10.39	x	97.38	x	0.63	x	0.7	=	216.86	(75)
Northeast 0.9x	0.77	x	2.1	x	97.38	x	0.63	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.2	x	97.38	x	0.63	x	0.7	=	95.24	(75)
Northeast 0.9x	0.54	x	10.39	x	91.1	x	0.63	x	0.7	=	202.87	(75)
Northeast 0.9x	0.77	x	2.1	x	91.1	x	0.63	x	0.7	=	58.47	(75)
Northeast 0.9x	0.77	x	3.2	x	91.1	x	0.63	x	0.7	=	89.09	(75)
Northeast 0.9x	0.54	x	10.39	x	72.63	x	0.63	x	0.7	=	161.73	(75)
Northeast 0.9x	0.77	x	2.1	x	72.63	x	0.63	x	0.7	=	46.61	(75)
Northeast 0.9x	0.77	x	3.2	x	72.63	x	0.63	x	0.7	=	71.03	(75)
Northeast 0.9x	0.54	x	10.39	x	50.42	x	0.63	x	0.7	=	112.28	(75)
Northeast 0.9x	0.77	x	2.1	x	50.42	x	0.63	x	0.7	=	32.36	(75)
Northeast 0.9x	0.77	x	3.2	x	50.42	x	0.63	x	0.7	=	49.31	(75)
Northeast 0.9x	0.54	x	10.39	x	28.07	x	0.63	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	2.1	x	28.07	x	0.63	x	0.7	=	18.01	(75)
Northeast 0.9x	0.77	x	3.2	x	28.07	x	0.63	x	0.7	=	27.45	(75)
Northeast 0.9x	0.54	x	10.39	x	14.2	x	0.63	x	0.7	=	31.61	(75)
Northeast 0.9x	0.77	x	2.1	x	14.2	x	0.63	x	0.7	=	9.11	(75)

Northeast 0.9x	0.77	x	3.2	x	14.2	x	0.63	x	0.7	=	13.88	(75)
Northeast 0.9x	0.54	x	10.39	x	9.21	x	0.63	x	0.7	=	20.52	(75)
Northeast 0.9x	0.77	x	2.1	x	9.21	x	0.63	x	0.7	=	5.91	(75)
Northeast 0.9x	0.77	x	3.2	x	9.21	x	0.63	x	0.7	=	9.01	(75)
Southeast 0.9x	0.77	x	2.7	x	36.79	x	0.63	x	0.7	=	30.36	(77)
Southeast 0.9x	0.77	x	2.7	x	62.67	x	0.63	x	0.7	=	51.72	(77)
Southeast 0.9x	0.77	x	2.7	x	85.75	x	0.63	x	0.7	=	70.76	(77)
Southeast 0.9x	0.77	x	2.7	x	106.25	x	0.63	x	0.7	=	87.67	(77)
Southeast 0.9x	0.77	x	2.7	x	119.01	x	0.63	x	0.7	=	98.2	(77)
Southeast 0.9x	0.77	x	2.7	x	118.15	x	0.63	x	0.7	=	97.49	(77)
Southeast 0.9x	0.77	x	2.7	x	113.91	x	0.63	x	0.7	=	93.99	(77)
Southeast 0.9x	0.77	x	2.7	x	104.39	x	0.63	x	0.7	=	86.14	(77)
Southeast 0.9x	0.77	x	2.7	x	92.85	x	0.63	x	0.7	=	76.62	(77)
Southeast 0.9x	0.77	x	2.7	x	69.27	x	0.63	x	0.7	=	57.16	(77)
Southeast 0.9x	0.77	x	2.7	x	44.07	x	0.63	x	0.7	=	36.37	(77)
Southeast 0.9x	0.77	x	2.7	x	31.49	x	0.63	x	0.7	=	25.98	(77)
Southwest 0.9x	0.77	x	5.8	x	36.79		0.63	x	0.7	=	65.22	(79)
Southwest 0.9x	0.77	x	5.8	x	62.67		0.63	x	0.7	=	111.09	(79)
Southwest 0.9x	0.77	x	5.8	x	85.75		0.63	x	0.7	=	152	(79)
Southwest 0.9x	0.77	x	5.8	x	106.25		0.63	x	0.7	=	188.34	(79)
Southwest 0.9x	0.77	x	5.8	x	119.01		0.63	x	0.7	=	210.95	(79)
Southwest 0.9x	0.77	x	5.8	x	118.15		0.63	x	0.7	=	209.43	(79)
Southwest 0.9x	0.77	x	5.8	x	113.91		0.63	x	0.7	=	201.91	(79)
Southwest 0.9x	0.77	x	5.8	x	104.39		0.63	x	0.7	=	185.04	(79)
Southwest 0.9x	0.77	x	5.8	x	92.85		0.63	x	0.7	=	164.59	(79)
Southwest 0.9x	0.77	x	5.8	x	69.27		0.63	x	0.7	=	122.78	(79)
Southwest 0.9x	0.77	x	5.8	x	44.07		0.63	x	0.7	=	78.12	(79)
Southwest 0.9x	0.77	x	5.8	x	31.49		0.63	x	0.7	=	55.81	(79)

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

(83)m=	138.98	251.15	381.93	537.41	660.53	681.52	646.33	550.54	435.15	287.9	169.09	117.24	(83)

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

(84)m=	588.62	698.58	813.58	943.2	1039.28	1034.41	982.99	894.31	792.88	671.73	582.67	553.43	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.92	0.8	0.65	0.72	0.91	0.99	1	1	(86)

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

(87)m=	19.24	19.41	19.72	20.15	20.55	20.84	20.95	20.92	20.68	20.17	19.63	19.21	(87)

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

(88)m=	19.67	19.67	19.67	19.68	19.69	19.69	19.69	19.7	19.69	19.69	19.68	19.68	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.7	0.49	0.56	0.85	0.98	1	1	(89)

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

(90)m=	17.35	17.61	18.06	18.68	19.23	19.58	19.68	19.66	19.42	18.71	17.93	17.32	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	17.63	17.87	18.3	18.89	19.43	19.77	19.86	19.85	19.61	18.93	18.18	17.6	(92)

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

(93)m=	17.63	17.87	18.3	18.89	19.43	19.77	19.86	19.85	19.61	18.93	18.18	17.6	(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	0.95	0.87	0.7	0.51	0.58	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	586.43	693.25	798.91	896.04	902.31	728.9	502.34	518.76	669.39	651.13	578.57	551.83	(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=	2179.97	2117.17	1922.28	1612.35	1244.67	825.4	521.18	550.1	882.5	1340.79	1790.71	2173.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1185.59	956.87	835.79	515.74	254.71	0	0	0	0	513.11	872.74	1206.52	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6341.07 (98)

Space heating requirement in kWh/m²/year 59.18 (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)													
	1185.59	956.87	835.79	515.74	254.71	0	0	0	0	513.11	872.74	1206.52	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1269.37	1024.49	894.85	552.18	272.71	0	0	0	0	549.37	934.41	1291.77	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6789.16 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91

Efficiency of water heater 80.3 (216)

(217)m=	88.69	88.56	88.26	87.58	86.04	80.3	80.3	80.3	80.3	87.48	88.36	88.75	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	242.53	214.07	225.56	202.99	200.05	188.78	180.87	201.62	203.85	211.53	221.46	236.53

Total = Sum(219a)$_{1...12}$ = 2529.85 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6789.16	
Water heating fuel used		2529.85	
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		420.97	(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	=	1466.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	546.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2012.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	218.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		2270.32	(272)

TER = 21.19 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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							4	x 10 =	40	(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) =	40	÷ (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

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.29	0.32	0.33	0.35

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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			10.73	x1/[1/(1.4)+ 0.04]		=	14.23			(27)
Windows Type 2			2.17	x1/[1/(1.4)+ 0.04]		=	2.88			(27)
Windows Type 3			3.3	x1/[1/(1.4)+ 0.04]		=	4.37			(27)
Windows Type 4			5.98	x1/[1/(1.4)+ 0.04]		=	7.93			(27)
Windows Type 5			2.79	x1/[1/(1.4)+ 0.04]		=	3.7			(27)
Floor Type 1			43.37	x	0.13	=	5.6381			(28)
Floor Type 2			34.11	x	0.13	=	4.4343			(28)
Walls Type1	44.81	27.57	17.24	x	0.18	=	3.1			(29)
Walls Type2	3.2	0	3.2	x	0.18	=	0.58			(29)
Walls Type3	43.07	0	43.07	x	0.18	=	7.75			(29)
Walls Type4	28.33	0	28.33	x	0.18	=	5.1			(29)
Walls Type5	56.95	0	56.95	x	0.18	=	10.25			(29)
Roof Type1	10.57	0	10.57	x	0.13	=	1.37			(30)
Roof Type2	4.76	0	4.76	x	0.13	=	0.62			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	62.16			(32b)

** 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) =	75.07	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	40709.07	(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		32.08	(36)

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

Total fabric heat loss	(33) + (36) =	107.15	(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=	58.05	57.77	57.5	56.22	55.98	54.86	54.86	54.66	55.29	55.98	56.47	56.97	(38)

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

(39)m=	165.2	164.92	164.65	163.37	163.13	162.01	162.01	161.81	162.44	163.13	163.61	164.12	

Average = Sum(39)$_{1…12}$ /12= 163.37 (39)

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

(40)m=	1.5	1.5	1.49	1.48	1.48	1.47	1.47	1.47	1.47	1.48	1.48	1.49	

Average = Sum(40)$_{1…12}$ /12= 1.48 (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 — 2.82 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 101.09 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2	

Total = Sum(44)$_{1…12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7	

Total = Sum(45)$_{1…12}$ = 1590.57 (45)

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

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
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=	50.96	46.03	50.96	48.86	48.42	44.87	46.36	48.42	48.86	50.96	49.32	50.96	(61)

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

(62)m=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66	(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=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66

Output from water heater (annual)$_{1...12}$ — 2175.54 (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=	67.57	59.46	62.23	55.36	53.5	46.94	44.69	50.09	50.65	57.54	61.23	65.84	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	24.25	21.53	17.51	13.26	9.91	8.37	9.04	11.75	15.77	20.03	23.38	24.92	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	271.96	274.78	267.67	252.53	233.42	215.46	203.46	200.63	207.75	222.89	242	259.96	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

Water heating gains (Table 5)

(72)m=	90.82	88.49	83.64	76.89	71.91	65.19	60.07	67.33	70.35	77.33	85.04	88.5	(72)

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

(73)m=	455.27	453.05	437.07	410.92	383.49	357.26	340.82	347.96	362.12	388.5	418.66	441.62	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	10.73	x	11.28	x	0.63	x	0.7	=	25.95	(75)
Northeast 0.9x	0.77	x	2.17	x	11.28	x	0.63	x	0.7	=	7.48	(75)
Northeast 0.9x	0.77	x	3.3	x	11.28	x	0.63	x	0.7	=	11.38	(75)
Northeast 0.9x	0.54	x	10.73	x	22.97	x	0.63	x	0.7	=	52.82	(75)
Northeast 0.9x	0.77	x	2.17	x	22.97	x	0.63	x	0.7	=	15.23	(75)
Northeast 0.9x	0.77	x	3.3	x	22.97	x	0.63	x	0.7	=	23.16	(75)
Northeast 0.9x	0.54	x	10.73	x	41.38	x	0.63	x	0.7	=	95.16	(75)
Northeast 0.9x	0.77	x	2.17	x	41.38	x	0.63	x	0.7	=	27.44	(75)
Northeast 0.9x	0.77	x	3.3	x	41.38	x	0.63	x	0.7	=	41.73	(75)
Northeast 0.9x	0.54	x	10.73	x	67.96	x	0.63	x	0.7	=	156.28	(75)
Northeast 0.9x	0.77	x	2.17	x	67.96	x	0.63	x	0.7	=	45.07	(75)
Northeast 0.9x	0.77	x	3.3	x	67.96	x	0.63	x	0.7	=	68.54	(75)
Northeast 0.9x	0.54	x	10.73	x	91.35	x	0.63	x	0.7	=	210.07	(75)
Northeast 0.9x	0.77	x	2.17	x	91.35	x	0.63	x	0.7	=	60.58	(75)
Northeast 0.9x	0.77	x	3.3	x	91.35	x	0.63	x	0.7	=	92.12	(75)
Northeast 0.9x	0.54	x	10.73	x	97.38	x	0.63	x	0.7	=	223.96	(75)
Northeast 0.9x	0.77	x	2.17	x	97.38	x	0.63	x	0.7	=	64.58	(75)
Northeast 0.9x	0.77	x	3.3	x	97.38	x	0.63	x	0.7	=	98.21	(75)
Northeast 0.9x	0.54	x	10.73	x	91.1	x	0.63	x	0.7	=	209.51	(75)
Northeast 0.9x	0.77	x	2.17	x	91.1	x	0.63	x	0.7	=	60.42	(75)
Northeast 0.9x	0.77	x	3.3	x	91.1	x	0.63	x	0.7	=	91.88	(75)
Northeast 0.9x	0.54	x	10.73	x	72.63	x	0.63	x	0.7	=	167.02	(75)
Northeast 0.9x	0.77	x	2.17	x	72.63	x	0.63	x	0.7	=	48.16	(75)
Northeast 0.9x	0.77	x	3.3	x	72.63	x	0.63	x	0.7	=	73.25	(75)
Northeast 0.9x	0.54	x	10.73	x	50.42	x	0.63	x	0.7	=	115.95	(75)
Northeast 0.9x	0.77	x	2.17	x	50.42	x	0.63	x	0.7	=	33.44	(75)
Northeast 0.9x	0.77	x	3.3	x	50.42	x	0.63	x	0.7	=	50.85	(75)
Northeast 0.9x	0.54	x	10.73	x	28.07	x	0.63	x	0.7	=	64.55	(75)
Northeast 0.9x	0.77	x	2.17	x	28.07	x	0.63	x	0.7	=	18.61	(75)
Northeast 0.9x	0.77	x	3.3	x	28.07	x	0.63	x	0.7	=	28.31	(75)
Northeast 0.9x	0.54	x	10.73	x	14.2	x	0.63	x	0.7	=	32.65	(75)
Northeast 0.9x	0.77	x	2.17	x	14.2	x	0.63	x	0.7	=	9.42	(75)

Northeast 0.9x	0.77	x	3.3	x	14.2	x	0.63	x	0.7	=	14.32	(75)
Northeast 0.9x	0.54	x	10.73	x	9.21	x	0.63	x	0.7	=	21.19	(75)
Northeast 0.9x	0.77	x	2.17	x	9.21	x	0.63	x	0.7	=	6.11	(75)
Northeast 0.9x	0.77	x	3.3	x	9.21	x	0.63	x	0.7	=	9.29	(75)
Southwest 0.9x	0.77	x	5.98	x	36.79		0.63	x	0.7	=	67.24	(79)
Southwest 0.9x	0.77	x	5.98	x	62.67		0.63	x	0.7	=	114.54	(79)
Southwest 0.9x	0.77	x	5.98	x	85.75		0.63	x	0.7	=	156.72	(79)
Southwest 0.9x	0.77	x	5.98	x	106.25		0.63	x	0.7	=	194.18	(79)
Southwest 0.9x	0.77	x	5.98	x	119.01		0.63	x	0.7	=	217.5	(79)
Southwest 0.9x	0.77	x	5.98	x	118.15		0.63	x	0.7	=	215.93	(79)
Southwest 0.9x	0.77	x	5.98	x	113.91		0.63	x	0.7	=	208.18	(79)
Southwest 0.9x	0.77	x	5.98	x	104.39		0.63	x	0.7	=	190.78	(79)
Southwest 0.9x	0.77	x	5.98	x	92.85		0.63	x	0.7	=	169.69	(79)
Southwest 0.9x	0.77	x	5.98	x	69.27		0.63	x	0.7	=	126.59	(79)
Southwest 0.9x	0.77	x	5.98	x	44.07		0.63	x	0.7	=	80.54	(79)
Southwest 0.9x	0.77	x	5.98	x	31.49		0.63	x	0.7	=	57.55	(79)
Northwest 0.9x	0.77	x	2.79	x	11.28	x	0.63	x	0.7	=	9.62	(81)
Northwest 0.9x	0.77	x	2.79	x	22.97	x	0.63	x	0.7	=	19.58	(81)
Northwest 0.9x	0.77	x	2.79	x	41.38	x	0.63	x	0.7	=	35.28	(81)
Northwest 0.9x	0.77	x	2.79	x	67.96	x	0.63	x	0.7	=	57.94	(81)
Northwest 0.9x	0.77	x	2.79	x	91.35	x	0.63	x	0.7	=	77.89	(81)
Northwest 0.9x	0.77	x	2.79	x	97.38	x	0.63	x	0.7	=	83.04	(81)
Northwest 0.9x	0.77	x	2.79	x	91.1	x	0.63	x	0.7	=	77.68	(81)
Northwest 0.9x	0.77	x	2.79	x	72.63	x	0.63	x	0.7	=	61.93	(81)
Northwest 0.9x	0.77	x	2.79	x	50.42	x	0.63	x	0.7	=	42.99	(81)
Northwest 0.9x	0.77	x	2.79	x	28.07	x	0.63	x	0.7	=	23.93	(81)
Northwest 0.9x	0.77	x	2.79	x	14.2	x	0.63	x	0.7	=	12.11	(81)
Northwest 0.9x	0.77	x	2.79	x	9.21	x	0.63	x	0.7	=	7.86	(81)

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

(83)m=	121.67	225.33	356.33	522.01	658.16	685.72	647.66	541.14	412.93	261.99	149.03	102	(83)

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

(84)m=	576.95	678.38	793.4	932.93	1041.65	1042.98	988.47	889.1	775.04	650.48	567.69	543.62	(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	0.98	0.92	0.8	0.66	0.73	0.92	0.99	1	1	(86)

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

(87)m=	19.25	19.41	19.72	20.14	20.55	20.84	20.95	20.92	20.67	20.15	19.63	19.22	(87)

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

(88)m=	19.69	19.69	19.69	19.7	19.7	19.71	19.71	19.71	19.71	19.7	19.7	19.7	(88)

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

(89)m=	1	1	0.99	0.96	0.88	0.7	0.49	0.57	0.86	0.98	1	1	(89)

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

(90)m=	17.38	17.62	18.06	18.68	19.25	19.6	19.69	19.68	19.42	18.71	17.94	17.35	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	17.65	17.87	18.3	18.89	19.43	19.77	19.87	19.85	19.6	18.91	18.18	17.61	(92)

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

(93)m=	17.65	17.87	18.3	18.89	19.43	19.77	19.87	19.85	19.6	18.91	18.18	17.61	(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	0.95	0.87	0.71	0.52	0.59	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	575.17	674.18	781.34	890.74	910.1	740	510.5	525.75	665.16	633.79	564.42	542.31	(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=	2204.77	2139.73	1942.47	1632.06	1261.65	838.36	529.73	558.94	893.47	1355.71	1812.65	2200.98	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1212.42	984.85	863.88	533.75	261.56	0	0	0	0	537.1	898.73	1234.05	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 6526.34 (98)

Space heating requirement in kWh/m²/year 59.18 (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)													
	1212.42	984.85	863.88	533.75	261.56	0	0	0	0	537.1	898.73	1234.05	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1298.1	1054.45	924.92	571.47	280.04	0	0	0	0	575.06	962.24	1321.25	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6987.52 (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)

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66	
Efficiency of water heater													80.3 (216)
(217)m=	88.71	88.6	88.31	87.64	86.09	80.3	80.3	80.3	80.3	87.57	88.41	88.77	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	243.33	214.75	226.23	203.81	200.87	189.67	181.72	202.57	204.81	212.04	222.14	237.31	

Total = Sum(219a)$_{1...12}$ = 2539.24 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6987.52	
Water heating fuel used			2539.24	
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			428.18	(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	=	1509.3	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	548.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2057.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	222.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		2318.93	(272)

TER = 21.03 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) =	0.16	(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)			0.41	(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) =	0.34	(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

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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.41

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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Windows Type 2			3.05	x1/[1/(1.4)+ 0.04]		=	4.04			(27)
Windows Type 3			4.26	x1/[1/(1.4)+ 0.04]		=	5.65			(27)
Windows Type 4			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Floor			14.69	x	0.13	=	1.9097			(28)
Walls Type1	67.78	15.9	51.88	x	0.18	=	9.34			(29)
Walls Type2	24.47	2.6	21.87	x	0.18	=	3.94			(29)
Walls Type3	5.93	0	5.93	x	0.18	=	1.07			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28644.15 (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 15.57 (36)

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

Total fabric heat loss (33) + (36) = 55.5 (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=	37.92	37.68	37.44	36.35	36.14	35.18	35.18	35.01	35.55	36.14	36.56	36.99	(38)

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

(39)m=	93.41	93.18	92.94	91.84	91.64	90.68	90.68	90.5	91.05	91.64	92.05	92.49	

Average = $Sum(39)_{1…12}$ /12= 91.84 (39)

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

(40)m=	1.26	1.26	1.25	1.24	1.24	1.22	1.22	1.22	1.23	1.24	1.24	1.25	

Average = $Sum(40)_{1…12}$ /12= 1.24 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1…12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1…12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1…12}$ 1951.28 (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

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

(67)m=	18.44	16.38	13.32	10.09	7.54	6.36	6.88	8.94	12	15.23	17.78	18.95	(67)

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

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	368.5	365.89	352.51	331.3	309.82	289.04	275.89	282.25	293.4	314.81	339.33	357.83	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	17.38	(75)
Northeast 0.9x	0.77	x	3.05	x	11.28	x	0.63	x	0.7	=	21.03	(75)
Northeast 0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	35.38	(75)
Northeast 0.9x	0.77	x	3.05	x	22.97	x	0.63	x	0.7	=	42.82	(75)
Northeast 0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	63.74	(75)
Northeast 0.9x	0.77	x	3.05	x	41.38	x	0.63	x	0.7	=	77.14	(75)
Northeast 0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	104.67	(75)
Northeast 0.9x	0.77	x	3.05	x	67.96	x	0.63	x	0.7	=	126.69	(75)
Northeast 0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	140.7	(75)
Northeast 0.9x	0.77	x	3.05	x	91.35	x	0.63	x	0.7	=	170.29	(75)
Northeast 0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	150	(75)
Northeast 0.9x	0.77	x	3.05	x	97.38	x	0.63	x	0.7	=	181.55	(75)
Northeast 0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	140.32	(75)
Northeast 0.9x	0.77	x	3.05	x	91.1	x	0.63	x	0.7	=	169.83	(75)
Northeast 0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	111.87	(75)
Northeast 0.9x	0.77	x	3.05	x	72.63	x	0.63	x	0.7	=	135.39	(75)
Northeast 0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	77.66	(75)
Northeast 0.9x	0.77	x	3.05	x	50.42	x	0.63	x	0.7	=	94	(75)
Northeast 0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	43.23	(75)
Northeast 0.9x	0.77	x	3.05	x	28.07	x	0.63	x	0.7	=	52.32	(75)
Northeast 0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	21.87	(75)
Northeast 0.9x	0.77	x	3.05	x	14.2	x	0.63	x	0.7	=	26.47	(75)
Northeast 0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	14.19	(75)
Northeast 0.9x	0.77	x	3.05	x	9.21	x	0.63	x	0.7	=	17.18	(75)
Southwest 0.9x	0.77	x	4.26	x	36.79		0.63	x	0.7	=	47.9	(79)
Southwest 0.9x	0.77	x	0.5	x	36.79		0.63	x	0.7	=	5.62	(79)
Southwest 0.9x	0.77	x	4.26	x	62.67		0.63	x	0.7	=	81.6	(79)
Southwest 0.9x	0.77	x	0.5	x	62.67		0.63	x	0.7	=	9.58	(79)
Southwest 0.9x	0.77	x	4.26	x	85.75		0.63	x	0.7	=	111.64	(79)
Southwest 0.9x	0.77	x	0.5	x	85.75		0.63	x	0.7	=	13.1	(79)
Southwest 0.9x	0.77	x	4.26	x	106.25		0.63	x	0.7	=	138.33	(79)
Southwest 0.9x	0.77	x	0.5	x	106.25		0.63	x	0.7	=	16.24	(79)
Southwest 0.9x	0.77	x	4.26	x	119.01		0.63	x	0.7	=	154.94	(79)
Southwest 0.9x	0.77	x	0.5	x	119.01		0.63	x	0.7	=	18.19	(79)
Southwest 0.9x	0.77	x	4.26	x	118.15		0.63	x	0.7	=	153.82	(79)
Southwest 0.9x	0.77	x	0.5	x	118.15		0.63	x	0.7	=	18.05	(79)
Southwest 0.9x	0.77	x	4.26	x	113.91		0.63	x	0.7	=	148.3	(79)
Southwest 0.9x	0.77	x	0.5	x	113.91		0.63	x	0.7	=	17.41	(79)
Southwest 0.9x	0.77	x	4.26	x	104.39		0.63	x	0.7	=	135.91	(79)

Southwest	0.9x	0.77	x	0.5	x	104.39	0.63	x	0.7	=	15.95	(79)
Southwest	0.9x	0.77	x	4.26	x	92.85	0.63	x	0.7	=	120.88	(79)
Southwest	0.9x	0.77	x	0.5	x	92.85	0.63	x	0.7	=	14.19	(79)
Southwest	0.9x	0.77	x	4.26	x	69.27	0.63	x	0.7	=	90.18	(79)
Southwest	0.9x	0.77	x	0.5	x	69.27	0.63	x	0.7	=	10.58	(79)
Southwest	0.9x	0.77	x	4.26	x	44.07	0.63	x	0.7	=	57.38	(79)
Southwest	0.9x	0.77	x	0.5	x	44.07	0.63	x	0.7	=	6.73	(79)
Southwest	0.9x	0.77	x	4.26	x	31.49	0.63	x	0.7	=	40.99	(79)
Southwest	0.9x	0.77	x	0.5	x	31.49	0.63	x	0.7	=	4.81	(79)

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

(83)m=	91.94	169.36	265.62	385.92	484.12	503.42	475.86	399.12	306.73	196.32	112.44	77.18	(83)

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

(84)m=	460.44	535.26	618.13	717.23	793.94	792.46	751.75	681.37	600.13	511.13	451.77	435.01	(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	0.59	0.84	0.98	1	1	(86)

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

(87)m=	19.63	19.8	20.08	20.46	20.78	20.95	20.99	20.98	20.85	20.43	19.97	19.61	(87)

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

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

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

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.4	0.46	0.77	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=	18.06	18.3	18.72	19.27	19.68	19.87	19.9	19.89	19.78	19.23	18.56	18.03	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.47	18.69	19.07	19.58	19.97	20.15	20.18	20.18	20.06	19.55	18.93	18.44	(92)

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

(93)m=	18.47	18.69	19.07	19.58	19.97	20.15	20.18	20.18	20.06	19.55	18.93	18.44	(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	0.81	0.61	0.43	0.49	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	458.27	530.04	603.03	664.71	640.01	480.72	321.53	335.62	469.48	489.2	447.6	433.42	(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=	1323.83	1285.19	1168.62	981	757.9	503.32	324.9	342.02	542.41	819.96	1088.58	1317.12	(97)

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

(98)m=	643.98	507.46	420.8	227.73	87.72	0	0	0	0	246.08	461.51	657.47

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3252.74 (98)

Space heating requirement in kWh/m²/year 43.92 (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)	643.98	507.46	420.8	227.73	87.72	0	0	0	0	246.08	461.51	657.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	689.48	543.32	450.54	243.82	93.92	0	0	0	0	263.47	494.12	703.93	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3482.6 (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)

	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Efficiency of water heater 80.3 (216)

(217)m=	87.81	87.61	87.13	85.96	83.7	80.3	80.3	80.3	80.3	86.04	87.35	87.9	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	224.11	196.22	205.28	184.55	183.5	168.46	161.4	179.92	181.91	193.33	203.28	218.63

Total = Sum(219a)$_{1...12}$ = 2300.57 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3482.6	
Water heating fuel used		2300.57	
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		325.7	(232)

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

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

TER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	752.24	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	496.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1249.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	169.04	(268)
Total CO2, kg/year		sum of (265)…(271) =		1457.13	(272)

TER = 19.67 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	76.06	(1a)	x	2.6	(2a)	=	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	197.76	(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

TER WorkSheet: New dwelling design stage

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

0.4	0.39	0.38	0.34	0.33	0.3	0.3	0.29	0.31	0.33	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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.6	x1/[1/(1.4)+ 0.04]		=	3.45			(27)
Windows Type 2			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Windows Type 3			4.39	x1/[1/(1.4)+ 0.04]		=	5.82			(27)
Windows Type 4			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Floor			14.36	x	0.13	=	1.8668			(28)
Walls Type1	38.14	16.41	21.73	x	0.18	=	3.91			(29)
Walls Type2	23.92	2.6	21.32	x	0.18	=	3.84			(29)
Walls Type3	5.95	0	5.95	x	0.18	=	1.07			(29)
Walls Type4	29.51	0	29.51	x	0.18	=	5.31			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) = 40.35 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28782.9 (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 — 15.62 (36)

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

Total fabric heat loss — (33) + (36) = 55.98 (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=	37.77	37.57	37.38	36.46	36.28	35.48	35.48	35.34	35.79	36.28	36.63	37	(38)

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

(39)m=	93.75	93.55	93.35	92.43	92.26	91.46	91.46	91.31	91.77	92.26	92.61	92.97

Average = Sum(39)$_{1…12}$ /12= 92.43 (39)

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

(40)m=	1.23	1.23	1.23	1.22	1.21	1.2	1.2	1.2	1.21	1.21	1.22	1.22

Average = Sum(40)$_{1…12}$ /12= 1.22 (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 — 2.38 (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 — 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Output from water heater (annual)$_{1\ldots12}$ 1973.65 (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

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

(67)m=	18.83	16.73	13.6	10.3	7.7	6.5	7.02	9.13	12.25	15.56	18.16	19.36	(67)

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

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

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

(73)m=	374.91	372.28	358.66	337.06	315.17	294	280.61	287.04	298.4	320.2	345.17	364.04	(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	2.6	x	11.28	x	0.63	x	0.7	=	17.93	(75)
Northeast 0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast 0.9x	0.77	x	2.6	x	22.97	x	0.63	x	0.7	=	36.5	(75)
Northeast 0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast 0.9x	0.77	x	2.6	x	41.38	x	0.63	x	0.7	=	65.76	(75)
Northeast 0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast 0.9x	0.77	x	2.6	x	67.96	x	0.63	x	0.7	=	107.99	(75)
Northeast 0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast 0.9x	0.77	x	2.6	x	91.35	x	0.63	x	0.7	=	145.17	(75)
Northeast 0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast 0.9x	0.77	x	2.6	x	97.38	x	0.63	x	0.7	=	154.76	(75)
Northeast 0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast 0.9x	0.77	x	2.6	x	91.1	x	0.63	x	0.7	=	144.78	(75)
Northeast 0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast 0.9x	0.77	x	2.6	x	72.63	x	0.63	x	0.7	=	115.42	(75)
Northeast 0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast 0.9x	0.77	x	2.6	x	50.42	x	0.63	x	0.7	=	80.13	(75)
Northeast 0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast 0.9x	0.77	x	2.6	x	28.07	x	0.63	x	0.7	=	44.6	(75)
Northeast 0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast 0.9x	0.77	x	2.6	x	14.2	x	0.63	x	0.7	=	22.56	(75)
Northeast 0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast 0.9x	0.77	x	2.6	x	9.21	x	0.63	x	0.7	=	14.64	(75)
Northeast 0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Southwest 0.9x	0.77	x	4.39	x	36.79		0.63	x	0.7	=	49.36	(79)
Southwest 0.9x	0.77	x	0.52	x	36.79		0.63	x	0.7	=	5.85	(79)
Southwest 0.9x	0.77	x	4.39	x	62.67		0.63	x	0.7	=	84.09	(79)
Southwest 0.9x	0.77	x	0.52	x	62.67		0.63	x	0.7	=	9.96	(79)
Southwest 0.9x	0.77	x	4.39	x	85.75		0.63	x	0.7	=	115.05	(79)
Southwest 0.9x	0.77	x	0.52	x	85.75		0.63	x	0.7	=	13.63	(79)
Southwest 0.9x	0.77	x	4.39	x	106.25		0.63	x	0.7	=	142.55	(79)
Southwest 0.9x	0.77	x	0.52	x	106.25		0.63	x	0.7	=	16.89	(79)
Southwest 0.9x	0.77	x	4.39	x	119.01		0.63	x	0.7	=	159.67	(79)
Southwest 0.9x	0.77	x	0.52	x	119.01		0.63	x	0.7	=	18.91	(79)
Southwest 0.9x	0.77	x	4.39	x	118.15		0.63	x	0.7	=	158.51	(79)
Southwest 0.9x	0.77	x	0.52	x	118.15		0.63	x	0.7	=	18.78	(79)
Southwest 0.9x	0.77	x	4.39	x	113.91		0.63	x	0.7	=	152.83	(79)
Southwest 0.9x	0.77	x	0.52	x	113.91		0.63	x	0.7	=	18.1	(79)
Southwest 0.9x	0.77	x	4.39	x	104.39		0.63	x	0.7	=	140.05	(79)

Southwest 0.9x	0.77	x	0.52	x	104.39		0.63	x	0.7	=	16.59	(79)
Southwest 0.9x	0.77	x	4.39	x	92.85		0.63	x	0.7	=	124.57	(79)
Southwest 0.9x	0.77	x	0.52	x	92.85		0.63	x	0.7	=	14.76	(79)
Southwest 0.9x	0.77	x	4.39	x	69.27		0.63	x	0.7	=	92.93	(79)
Southwest 0.9x	0.77	x	0.52	x	69.27		0.63	x	0.7	=	11.01	(79)
Southwest 0.9x	0.77	x	4.39	x	44.07		0.63	x	0.7	=	59.13	(79)
Southwest 0.9x	0.77	x	0.52	x	44.07		0.63	x	0.7	=	7	(79)
Southwest 0.9x	0.77	x	4.39	x	31.49		0.63	x	0.7	=	42.25	(79)
Southwest 0.9x	0.77	x	0.52	x	31.49		0.63	x	0.7	=	5	(79)

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

(83)m=	94.87	174.76	274.1	398.27	499.62	519.55	491.11	411.89	316.54	202.58	116.03	79.63	(83)

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

(84)m=	469.78	547.04	632.76	735.33	814.79	813.55	771.71	698.94	614.94	522.79	461.2	443.67	(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	0.67	0.51	0.58	0.84	0.97	1	1	(86)

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

(87)m=	19.67	19.83	20.11	20.49	20.8	20.95	20.99	20.98	20.86	20.45	19.99	19.64	(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	19.91	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	0.98	0.93	0.8	0.58	0.39	0.45	0.77	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=	18.12	18.36	18.77	19.31	19.72	19.89	19.91	19.91	19.8	19.27	18.61	18.09	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.52	18.74	19.12	19.61	19.99	20.16	20.19	20.19	20.07	19.57	18.96	18.48	(92)

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

(93)m=	18.52	18.74	19.12	19.61	19.99	20.16	20.19	20.19	20.07	19.57	18.96	18.48	(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	0.8	0.6	0.42	0.49	0.78	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	467.64	541.79	617.23	680.35	652.63	487.63	325.25	339.85	478.24	500.19	457.03	442.12	(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=	1332.86	1294.52	1177.69	990.26	765.01	508.48	328.26	345.66	548	827.94	1098.27	1327.85	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	643.72	505.84	416.98	223.14	83.61	0	0	0	0	243.85	461.7	658.99	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3237.83 (98)

Space heating requirement in kWh/m²/year 42.57 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [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)	643.72	505.84	416.98	223.14	83.61	0	0	0	0	243.85	461.7	658.99	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	689.21	541.58	446.45	238.91	89.52	0	0	0	0	261.08	494.32	705.56	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3466.63 (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)	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	
Efficiency of water heater													80.3 (216)
(217)m=	87.79	87.58	87.09	85.88	83.57	80.3	80.3	80.3	80.3	85.98	87.32	87.88	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	226.73	198.53	207.74	186.84	185.9	170.39	163.25	181.98	183.99	195.66	205.66	221.18

Total = Sum(219a)$_{1...12}$ = 2327.86 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3466.63	
Water heating fuel used		2327.86	
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		332.6	(232)

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

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

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Space heating (main system 1)	(211) x	0.216	=	748.79	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	502.82	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1251.61	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	172.62	(268)
Total CO2, kg/year		sum of (265)…(271) =		1463.15	(272)

TER = 19.24 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) =	0.16	(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)	0.41	(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) =	0.34	(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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.41

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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Windows Type 2			3.05	x1/[1/(1.4)+ 0.04]		=	4.04			(27)
Windows Type 3			4.26	x1/[1/(1.4)+ 0.04]		=	5.65			(27)
Windows Type 4			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Walls Type1	67.78	15.9	51.88	x	0.18	=	9.34			(29)
Walls Type2	24.47	2.6	21.87	x	0.18	=	3.94			(29)
Walls Type3	5.93	0	5.93	x	0.18	=	1.07			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

* *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) = 38.02 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28717.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.42 (36)

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

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Total fabric heat loss	(33) + (36) =	46.44	(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=	37.92	37.68	37.44	36.35	36.14	35.18	35.18	35.01	35.55	36.14	36.56	36.99	(38)

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

(39)m=	84.36	84.12	83.88	82.78	82.58	81.62	81.62	81.44	81.99	82.58	82.99	83.43	

Average = $Sum(39)_{1...12}$ /12= 82.78 (39)

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

(40)m=	1.14	1.14	1.13	1.12	1.12	1.1	1.1	1.1	1.11	1.12	1.12	1.13	

Average = $Sum(40)_{1...12}$ /12= 1.12 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1...12}$ — 1951.28 (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

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

(67)m=	18.44	16.38	13.32	10.09	7.54	6.36	6.88	8.94	12	15.23	17.78	18.95	(67)

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

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	368.5	365.89	352.51	331.3	309.82	289.04	275.89	282.25	293.4	314.81	339.33	357.83	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	17.38	(75)
Northeast	0.9x	0.77	x	3.05	x	11.28	x	0.63	x	0.7	=	21.03	(75)
Northeast	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	35.38	(75)
Northeast	0.9x	0.77	x	3.05	x	22.97	x	0.63	x	0.7	=	42.82	(75)
Northeast	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	63.74	(75)
Northeast	0.9x	0.77	x	3.05	x	41.38	x	0.63	x	0.7	=	77.14	(75)
Northeast	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	104.67	(75)
Northeast	0.9x	0.77	x	3.05	x	67.96	x	0.63	x	0.7	=	126.69	(75)
Northeast	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	140.7	(75)
Northeast	0.9x	0.77	x	3.05	x	91.35	x	0.63	x	0.7	=	170.29	(75)
Northeast	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	150	(75)
Northeast	0.9x	0.77	x	3.05	x	97.38	x	0.63	x	0.7	=	181.55	(75)
Northeast	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	140.32	(75)
Northeast	0.9x	0.77	x	3.05	x	91.1	x	0.63	x	0.7	=	169.83	(75)
Northeast	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	111.87	(75)
Northeast	0.9x	0.77	x	3.05	x	72.63	x	0.63	x	0.7	=	135.39	(75)
Northeast	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	77.66	(75)
Northeast	0.9x	0.77	x	3.05	x	50.42	x	0.63	x	0.7	=	94	(75)
Northeast	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	43.23	(75)
Northeast	0.9x	0.77	x	3.05	x	28.07	x	0.63	x	0.7	=	52.32	(75)
Northeast	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	21.87	(75)
Northeast	0.9x	0.77	x	3.05	x	14.2	x	0.63	x	0.7	=	26.47	(75)
Northeast	0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	14.19	(75)
Northeast	0.9x	0.77	x	3.05	x	9.21	x	0.63	x	0.7	=	17.18	(75)
Southwest	0.9x	0.77	x	4.26	x	36.79		0.63	x	0.7	=	47.9	(79)
Southwest	0.9x	0.77	x	0.5	x	36.79		0.63	x	0.7	=	5.62	(79)
Southwest	0.9x	0.77	x	4.26	x	62.67		0.63	x	0.7	=	81.6	(79)
Southwest	0.9x	0.77	x	0.5	x	62.67		0.63	x	0.7	=	9.58	(79)
Southwest	0.9x	0.77	x	4.26	x	85.75		0.63	x	0.7	=	111.64	(79)
Southwest	0.9x	0.77	x	0.5	x	85.75		0.63	x	0.7	=	13.1	(79)
Southwest	0.9x	0.77	x	4.26	x	106.25		0.63	x	0.7	=	138.33	(79)
Southwest	0.9x	0.77	x	0.5	x	106.25		0.63	x	0.7	=	16.24	(79)
Southwest	0.9x	0.77	x	4.26	x	119.01		0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	0.5	x	119.01		0.63	x	0.7	=	18.19	(79)
Southwest	0.9x	0.77	x	4.26	x	118.15		0.63	x	0.7	=	153.82	(79)
Southwest	0.9x	0.77	x	0.5	x	118.15		0.63	x	0.7	=	18.05	(79)
Southwest	0.9x	0.77	x	4.26	x	113.91		0.63	x	0.7	=	148.3	(79)
Southwest	0.9x	0.77	x	0.5	x	113.91		0.63	x	0.7	=	17.41	(79)
Southwest	0.9x	0.77	x	4.26	x	104.39		0.63	x	0.7	=	135.91	(79)

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Southwest	0.9x	0.77	x	0.5	x	104.39	0.63	x	0.7	=	15.95	(79)
Southwest	0.9x	0.77	x	4.26	x	92.85	0.63	x	0.7	=	120.88	(79)
Southwest	0.9x	0.77	x	0.5	x	92.85	0.63	x	0.7	=	14.19	(79)
Southwest	0.9x	0.77	x	4.26	x	69.27	0.63	x	0.7	=	90.18	(79)
Southwest	0.9x	0.77	x	0.5	x	69.27	0.63	x	0.7	=	10.58	(79)
Southwest	0.9x	0.77	x	4.26	x	44.07	0.63	x	0.7	=	57.38	(79)
Southwest	0.9x	0.77	x	0.5	x	44.07	0.63	x	0.7	=	6.73	(79)
Southwest	0.9x	0.77	x	4.26	x	31.49	0.63	x	0.7	=	40.99	(79)
Southwest	0.9x	0.77	x	0.5	x	31.49	0.63	x	0.7	=	4.81	(79)

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

(83)m=	91.94	169.36	265.62	385.92	484.12	503.42	475.86	399.12	306.73	196.32	112.44	77.18	(83)

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

(84)m=	460.44	535.26	618.13	717.23	793.94	792.46	751.75	681.37	600.13	511.13	451.77	435.01	(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	0.82	0.63	0.47	0.54	0.81	0.97	1	1	(86)

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

(87)m=	19.79	19.95	20.23	20.58	20.85	20.97	20.99	20.99	20.9	20.54	20.1	19.77	(87)

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

(88)m=	19.97	19.97	19.97	19.99	19.99	20	20	20	20	19.99	19.98	19.98	(88)

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

(89)m=	1	0.99	0.98	0.92	0.77	0.54	0.37	0.43	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=	18.36	18.6	19	19.51	19.85	19.98	20	20	19.92	19.45	18.83	18.33	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	18.74	18.96	19.32	19.79	20.11	20.24	20.26	20.26	20.18	19.74	19.16	18.71	(92)

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

(93)m=	18.74	18.96	19.32	19.79	20.11	20.24	20.26	20.26	20.18	19.74	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=	1	0.99	0.97	0.92	0.78	0.57	0.4	0.46	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	458.36	529.97	601.85	657.25	616.88	448.58	297.17	311.16	450.96	486.75	447.56	433.51	(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=	1217.98	1182.32	1075.23	901.41	694.85	460.44	298.65	314.19	498.1	754.59	1000.92	1210.52	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	565.16	438.38	352.19	175.8	58.01	0	0	0	0	199.28	398.42	578.09		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2765.33 (98)

Space heating requirement in kWh/m²/year 37.34 (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)	565.16	438.38	352.19	175.8	58.01	0	0	0	0	199.28	398.42	578.09		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	605.09	469.36	377.08	188.22	62.11	0	0	0	0	213.36	426.57	618.94		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2960.74	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18		
Efficiency of water heater													80.3	(216)
(217)m=	87.56	87.31	86.73	85.31	82.84	80.3	80.3	80.3	80.3	85.51	87.03	87.65		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	224.77	196.9	206.23	185.96	185.41	168.46	161.4	179.92	181.91	194.52	204.03	219.26		
Total = Sum(219a)$_{1...12}$ =													2308.77	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2960.74	
Water heating fuel used			2308.77	
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			325.7	(232)

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

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

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Space heating (main system 1)	(211) x	0.216	=	639.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	498.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1138.21	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	169.04	(268)
Total CO2, kg/year		sum of (265)…(271) =		1346.18	(272)

TER = 18.18 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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	0.33	0.3	0.3	0.29	0.31	0.33	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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.6	x1/[1/(1.4)+ 0.04]		=	3.45			(27)
Windows Type 2			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Windows Type 3			4.39	x1/[1/(1.4)+ 0.04]		=	5.82			(27)
Windows Type 4			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Walls Type1	38.14	16.41	21.73	x	0.18	=	3.91			(29)
Walls Type2	23.92	2.6	21.32	x	0.18	=	3.84			(29)
Walls Type3	5.95	0	5.95	x	0.18	=	1.07			(29)
Walls Type4	29.51	0	29.51	x	0.18	=	5.31			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) = 38.49 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28854.7 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.38 (36)

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

Total fabric heat loss (33) + (36) = 46.87 (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=	37.77	37.57	37.38	36.46	36.28	35.48	35.48	35.34	35.79	36.28	36.63	37	(38)

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

(39)m=	84.64	84.44	84.24	83.33	83.15	82.35	82.35	82.2	82.66	83.15	83.5	83.86	

Average = $Sum(39)_{1...12}$ /12= 83.32 (39)

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

(40)m=	1.11	1.11	1.11	1.1	1.09	1.08	1.08	1.08	1.09	1.09	1.1	1.1	

Average = $Sum(40)_{1...12}$ /12= 1.1 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Output from water heater (annual)1...12 | 1973.65 | (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.83	16.73	13.6	10.3	7.7	6.5	7.02	9.13	12.25	15.56	18.16	19.36	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

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

(73)m=	374.91	372.28	358.66	337.06	315.17	294	280.61	287.04	298.4	320.2	345.17	364.04	(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	2.6	x	11.28	x	0.63	x	0.7	=	17.93	(75)
Northeast	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast	0.9x	0.77	x	2.6	x	22.97	x	0.63	x	0.7	=	36.5	(75)
Northeast	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast	0.9x	0.77	x	2.6	x	41.38	x	0.63	x	0.7	=	65.76	(75)
Northeast	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast	0.9x	0.77	x	2.6	x	67.96	x	0.63	x	0.7	=	107.99	(75)
Northeast	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast	0.9x	0.77	x	2.6	x	91.35	x	0.63	x	0.7	=	145.17	(75)
Northeast	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast	0.9x	0.77	x	2.6	x	97.38	x	0.63	x	0.7	=	154.76	(75)
Northeast	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast	0.9x	0.77	x	2.6	x	91.1	x	0.63	x	0.7	=	144.78	(75)
Northeast	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast	0.9x	0.77	x	2.6	x	72.63	x	0.63	x	0.7	=	115.42	(75)
Northeast	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast	0.9x	0.77	x	2.6	x	50.42	x	0.63	x	0.7	=	80.13	(75)
Northeast	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast	0.9x	0.77	x	2.6	x	28.07	x	0.63	x	0.7	=	44.6	(75)
Northeast	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast	0.9x	0.77	x	2.6	x	14.2	x	0.63	x	0.7	=	22.56	(75)
Northeast	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast	0.9x	0.77	x	2.6	x	9.21	x	0.63	x	0.7	=	14.64	(75)
Northeast	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Southwest	0.9x	0.77	x	4.39	x	36.79		0.63	x	0.7	=	49.36	(79)
Southwest	0.9x	0.77	x	0.52	x	36.79		0.63	x	0.7	=	5.85	(79)
Southwest	0.9x	0.77	x	4.39	x	62.67		0.63	x	0.7	=	84.09	(79)
Southwest	0.9x	0.77	x	0.52	x	62.67		0.63	x	0.7	=	9.96	(79)
Southwest	0.9x	0.77	x	4.39	x	85.75		0.63	x	0.7	=	115.05	(79)
Southwest	0.9x	0.77	x	0.52	x	85.75		0.63	x	0.7	=	13.63	(79)
Southwest	0.9x	0.77	x	4.39	x	106.25		0.63	x	0.7	=	142.55	(79)
Southwest	0.9x	0.77	x	0.52	x	106.25		0.63	x	0.7	=	16.89	(79)
Southwest	0.9x	0.77	x	4.39	x	119.01		0.63	x	0.7	=	159.67	(79)
Southwest	0.9x	0.77	x	0.52	x	119.01		0.63	x	0.7	=	18.91	(79)
Southwest	0.9x	0.77	x	4.39	x	118.15		0.63	x	0.7	=	158.51	(79)
Southwest	0.9x	0.77	x	0.52	x	118.15		0.63	x	0.7	=	18.78	(79)
Southwest	0.9x	0.77	x	4.39	x	113.91		0.63	x	0.7	=	152.83	(79)
Southwest	0.9x	0.77	x	0.52	x	113.91		0.63	x	0.7	=	18.1	(79)
Southwest	0.9x	0.77	x	4.39	x	104.39		0.63	x	0.7	=	140.05	(79)

Southwest	0.9x	0.77	x	0.52	x	104.39	0.63	x	0.7	=	16.59	(79)
Southwest	0.9x	0.77	x	4.39	x	92.85	0.63	x	0.7	=	124.57	(79)
Southwest	0.9x	0.77	x	0.52	x	92.85	0.63	x	0.7	=	14.76	(79)
Southwest	0.9x	0.77	x	4.39	x	69.27	0.63	x	0.7	=	92.93	(79)
Southwest	0.9x	0.77	x	0.52	x	69.27	0.63	x	0.7	=	11.01	(79)
Southwest	0.9x	0.77	x	4.39	x	44.07	0.63	x	0.7	=	59.13	(79)
Southwest	0.9x	0.77	x	0.52	x	44.07	0.63	x	0.7	=	7	(79)
Southwest	0.9x	0.77	x	4.39	x	31.49	0.63	x	0.7	=	42.25	(79)
Southwest	0.9x	0.77	x	0.52	x	31.49	0.63	x	0.7	=	5	(79)

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

(83)m=	94.87	174.76	274.1	398.27	499.62	519.55	491.11	411.89	316.54	202.58	116.03	79.63	(83)

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

(84)m=	469.78	547.04	632.76	735.33	814.79	813.55	771.71	698.94	614.94	522.79	461.2	443.67	(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	0.82	0.62	0.46	0.53	0.81	0.97	1	1	(86)

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

(87)m=	19.83	19.99	20.25	20.6	20.87	20.97	21	20.99	20.91	20.55	20.13	19.8	(87)

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

(88)m=	19.99	19.99	19.99	20	20.01	20.01	20.01	20.02	20.01	20.01	20	20	(88)

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

(89)m=	1	0.99	0.98	0.92	0.76	0.54	0.36	0.42	0.73	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=	18.43	18.66	19.05	19.55	19.88	20	20.01	20.01	19.94	19.49	18.87	18.39	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.78	19	19.36	19.82	20.13	20.25	20.26	20.26	20.19	19.76	19.19	18.75	(92)

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

(93)m=	18.78	19	19.36	19.82	20.13	20.25	20.26	20.26	20.19	19.76	19.19	18.75	(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	0.91	0.77	0.56	0.39	0.45	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	467.72	541.69	615.91	672.21	627.89	454.41	300.46	314.86	458.64	497.53	456.97	442.2	(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=	1225.82	1190.51	1083.23	909.76	701.16	465.16	301.76	317.56	503.16	761.86	1009.69	1220.13	(97)

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

(98)m=	564.03	436.01	347.69	171.04	54.51	0	0	0	0	196.67	397.96	578.78

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2746.68 (98)

Space heating requirement in kWh/m²/year 36.11 (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)	564.03	436.01	347.69	171.04	54.51	0	0	0	0	196.67	397.96	578.78		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	603.88	466.82	372.26	183.12	58.37	0	0	0	0	210.57	426.09	619.68		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2940.77	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38		
Efficiency of water heater													80.3	(216)
(217)m=	87.53	87.27	86.67	85.21	82.7	80.3	80.3	80.3	80.3	85.45	87	87.63		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	227.42	199.24	208.74	188.3	187.85	170.39	163.25	181.98	183.99	196.9	206.43	221.82		
Total = Sum(219a)$_{1...12}$ =													2336.31	(219)

Annual totals	kWh/year	kWh/year	
Space heating fuel used, main system 1		2940.77	
Water heating fuel used		2336.31	
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		332.6	(232)

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

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

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Space heating (main system 1)	(211) x	0.216	=	635.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	504.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1139.85	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	172.62	(268)
Total CO2, kg/year		sum of (265)…(271) =		1351.39	(272)

TER = 17.77 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) =	0.16	(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)	0.41	(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) =	0.34	(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

0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.41

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=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

(25)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Windows Type 2			3.05	x1/[1/(1.4)+ 0.04]		=	4.04			(27)
Windows Type 3			4.26	x1/[1/(1.4)+ 0.04]		=	5.65			(27)
Windows Type 4			0.5	x1/[1/(1.4)+ 0.04]		=	0.66			(27)
Walls Type1	67.78	15.9	51.88	x	0.18	=	9.34			(29)
Walls Type2	24.47	2.6	21.87	x	0.18	=	3.94			(29)
Walls Type3	5.93	0	5.93	x	0.18	=	1.07			(29)
Roof	19.72	0	19.72	x	0.13	=	2.56			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.59 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26923.08 (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 19.98 (36)

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

Total fabric heat loss (33) + (36) = 60.57 (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=	37.92	37.68	37.44	36.35	36.14	35.18	35.18	35.01	35.55	36.14	36.56	36.99	(38)

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

(39)m=	98.48	98.25	98.01	96.91	96.71	95.75	95.75	95.57	96.12	96.71	97.12	97.56	

Average = $Sum(39)_{1...12}$ /12= 96.91 (39)

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

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

Average = $Sum(40)_{1...12}$ /12= 1.31 (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 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1...12}$ | 1951.28 | (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

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

(67)m=	18.44	16.38	13.32	10.09	7.54	6.36	6.88	8.94	12	15.23	17.78	18.95	(67)

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

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

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

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	368.5	365.89	352.51	331.3	309.82	289.04	275.89	282.25	293.4	314.81	339.33	357.83	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.52	x	11.28	x	0.63	x	0.7	=	17.38	(75)
Northeast	0.9x	0.77	x	3.05	x	11.28	x	0.63	x	0.7	=	21.03	(75)
Northeast	0.9x	0.77	x	2.52	x	22.97	x	0.63	x	0.7	=	35.38	(75)
Northeast	0.9x	0.77	x	3.05	x	22.97	x	0.63	x	0.7	=	42.82	(75)
Northeast	0.9x	0.77	x	2.52	x	41.38	x	0.63	x	0.7	=	63.74	(75)
Northeast	0.9x	0.77	x	3.05	x	41.38	x	0.63	x	0.7	=	77.14	(75)
Northeast	0.9x	0.77	x	2.52	x	67.96	x	0.63	x	0.7	=	104.67	(75)
Northeast	0.9x	0.77	x	3.05	x	67.96	x	0.63	x	0.7	=	126.69	(75)
Northeast	0.9x	0.77	x	2.52	x	91.35	x	0.63	x	0.7	=	140.7	(75)
Northeast	0.9x	0.77	x	3.05	x	91.35	x	0.63	x	0.7	=	170.29	(75)
Northeast	0.9x	0.77	x	2.52	x	97.38	x	0.63	x	0.7	=	150	(75)
Northeast	0.9x	0.77	x	3.05	x	97.38	x	0.63	x	0.7	=	181.55	(75)
Northeast	0.9x	0.77	x	2.52	x	91.1	x	0.63	x	0.7	=	140.32	(75)
Northeast	0.9x	0.77	x	3.05	x	91.1	x	0.63	x	0.7	=	169.83	(75)
Northeast	0.9x	0.77	x	2.52	x	72.63	x	0.63	x	0.7	=	111.87	(75)
Northeast	0.9x	0.77	x	3.05	x	72.63	x	0.63	x	0.7	=	135.39	(75)
Northeast	0.9x	0.77	x	2.52	x	50.42	x	0.63	x	0.7	=	77.66	(75)
Northeast	0.9x	0.77	x	3.05	x	50.42	x	0.63	x	0.7	=	94	(75)
Northeast	0.9x	0.77	x	2.52	x	28.07	x	0.63	x	0.7	=	43.23	(75)
Northeast	0.9x	0.77	x	3.05	x	28.07	x	0.63	x	0.7	=	52.32	(75)
Northeast	0.9x	0.77	x	2.52	x	14.2	x	0.63	x	0.7	=	21.87	(75)
Northeast	0.9x	0.77	x	3.05	x	14.2	x	0.63	x	0.7	=	26.47	(75)
Northeast	0.9x	0.77	x	2.52	x	9.21	x	0.63	x	0.7	=	14.19	(75)
Northeast	0.9x	0.77	x	3.05	x	9.21	x	0.63	x	0.7	=	17.18	(75)
Southwest	0.9x	0.77	x	4.26	x	36.79		0.63	x	0.7	=	47.9	(79)
Southwest	0.9x	0.77	x	0.5	x	36.79		0.63	x	0.7	=	5.62	(79)
Southwest	0.9x	0.77	x	4.26	x	62.67		0.63	x	0.7	=	81.6	(79)
Southwest	0.9x	0.77	x	0.5	x	62.67		0.63	x	0.7	=	9.58	(79)
Southwest	0.9x	0.77	x	4.26	x	85.75		0.63	x	0.7	=	111.64	(79)
Southwest	0.9x	0.77	x	0.5	x	85.75		0.63	x	0.7	=	13.1	(79)
Southwest	0.9x	0.77	x	4.26	x	106.25		0.63	x	0.7	=	138.33	(79)
Southwest	0.9x	0.77	x	0.5	x	106.25		0.63	x	0.7	=	16.24	(79)
Southwest	0.9x	0.77	x	4.26	x	119.01		0.63	x	0.7	=	154.94	(79)
Southwest	0.9x	0.77	x	0.5	x	119.01		0.63	x	0.7	=	18.19	(79)
Southwest	0.9x	0.77	x	4.26	x	118.15		0.63	x	0.7	=	153.82	(79)
Southwest	0.9x	0.77	x	0.5	x	118.15		0.63	x	0.7	=	18.05	(79)
Southwest	0.9x	0.77	x	4.26	x	113.91		0.63	x	0.7	=	148.3	(79)
Southwest	0.9x	0.77	x	0.5	x	113.91		0.63	x	0.7	=	17.41	(79)
Southwest	0.9x	0.77	x	4.26	x	104.39		0.63	x	0.7	=	135.91	(79)

Southwest	0.9x	0.77	x	0.5	x	104.39	0.63	x	0.7	=	15.95	(79)
Southwest	0.9x	0.77	x	4.26	x	92.85	0.63	x	0.7	=	120.88	(79)
Southwest	0.9x	0.77	x	0.5	x	92.85	0.63	x	0.7	=	14.19	(79)
Southwest	0.9x	0.77	x	4.26	x	69.27	0.63	x	0.7	=	90.18	(79)
Southwest	0.9x	0.77	x	0.5	x	69.27	0.63	x	0.7	=	10.58	(79)
Southwest	0.9x	0.77	x	4.26	x	44.07	0.63	x	0.7	=	57.38	(79)
Southwest	0.9x	0.77	x	0.5	x	44.07	0.63	x	0.7	=	6.73	(79)
Southwest	0.9x	0.77	x	4.26	x	31.49	0.63	x	0.7	=	40.99	(79)
Southwest	0.9x	0.77	x	0.5	x	31.49	0.63	x	0.7	=	4.81	(79)

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

(83)m=	91.94	169.36	265.62	385.92	484.12	503.42	475.86	399.12	306.73	196.32	112.44	77.18	(83)

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

(84)m=	460.44	535.26	618.13	717.23	793.94	792.46	751.75	681.37	600.13	511.13	451.77	435.01	(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	0.96	0.87	0.7	0.54	0.61	0.86	0.98	1	1	(86)

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

(87)m=	19.54	19.71	20	20.4	20.74	20.93	20.98	20.97	20.82	20.38	19.89	19.52	(87)

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

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

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

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.47	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=	17.89	18.14	18.56	19.14	19.59	19.8	19.84	19.84	19.7	19.11	18.41	17.86	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.33	18.55	18.94	19.47	19.89	20.1	20.14	20.13	19.99	19.44	18.8	18.3	(92)

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

(93)m=	18.33	18.55	18.94	19.47	19.89	20.1	20.14	20.13	19.99	19.44	18.8	18.3	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.82	0.63	0.44	0.51	0.8	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	458.2	530.02	603.44	667.64	649.91	496.2	334.09	347.95	477.5	490.11	447.58	433.36	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1381.47	1341.18	1219.39	1024.08	791.84	526.42	338.99	356.94	566.14	855.33	1136.23	1375.17	(97)

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

(98)m=	686.91	545.1	458.27	256.64	105.6	0	0	0	0	271.72	495.83	700.71

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3520.78 (98)

Space heating requirement in kWh/m²/year 47.54 (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)	686.91	545.1	458.27	256.64	105.6	0	0	0	0	271.72	495.83	700.71		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	735.45	583.61	490.65	274.78	113.06	0	0	0	0	290.93	530.87	750.22		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3769.57	(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)	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18		
Efficiency of water heater													80.3	(216)
(217)m=	87.94	87.75	87.32	86.26	84.13	80.3	80.3	80.3	80.3	86.28	87.5	88.02		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	223.79	195.9	204.84	183.92	182.56	168.46	161.4	179.92	181.91	192.78	202.93	218.34		
Total = Sum(219a)$_{1...12}$ =													2296.75	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3769.57	
Water heating fuel used		2296.75	
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		325.7	(232)

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

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

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Space heating (main system 1)	(211)	x	0.216	=	814.23	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	496.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1310.33	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	169.04	(268)
Total CO2, kg/year			sum of (265)…(271) =		1518.29	(272)

TER =	20.5	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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	0.33	0.3	0.3	0.29	0.31	0.33	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			2.6	x	1	=	2.6			(26)
Windows Type 1			2.6	x1/[1/(1.4)+ 0.04]		=	3.45			(27)
Windows Type 2			3.15	x1/[1/(1.4)+ 0.04]		=	4.18			(27)
Windows Type 3			4.39	x1/[1/(1.4)+ 0.04]		=	5.82			(27)
Windows Type 4			0.52	x1/[1/(1.4)+ 0.04]		=	0.69			(27)
Walls Type1	38.14	16.41	21.73	x	0.18	=	3.91			(29)
Walls Type2	23.92	2.6	21.32	x	0.18	=	3.84			(29)
Walls Type3	5.95	0	5.95	x	0.18	=	1.07			(29)
Walls Type4	29.51	0	29.51	x	0.18	=	5.31			(29)
Roof	20.45	0	20.45	x	0.13	=	2.66			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 41.15 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26993.75 (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		20.43	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	61.58	(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=	37.77	37.57	37.38	36.46	36.28	35.48	35.48	35.34	35.79	36.28	36.63	37	(38)

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

(39)m=	99.35	99.15	98.96	98.04	97.86	97.06	97.06	96.92	97.37	97.86	98.21	98.58	

Average = $Sum(39)_{1...12}$ /12= 98.04 (39)

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

(40)m=	1.31	1.3	1.3	1.29	1.29	1.28	1.28	1.27	1.28	1.29	1.29	1.3

Average = $Sum(40)_{1...12}$ /12= 1.29 (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	2.38	(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	90.82	(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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	

Output from water heater (annual)$_{1...12}$ — 1973.65 (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

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

(67)m=	18.83	16.73	13.6	10.3	7.7	6.5	7.02	9.13	12.25	15.56	18.16	19.36	(67)

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

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

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

(73)m=	374.91	372.28	358.66	337.06	315.17	294	280.61	287.04	298.4	320.2	345.17	364.04	(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	2.6	x	11.28	x	0.63	x	0.7	=	17.93	(75)
Northeast	0.9x	0.77	x	3.15	x	11.28	x	0.63	x	0.7	=	21.72	(75)
Northeast	0.9x	0.77	x	2.6	x	22.97	x	0.63	x	0.7	=	36.5	(75)
Northeast	0.9x	0.77	x	3.15	x	22.97	x	0.63	x	0.7	=	44.22	(75)
Northeast	0.9x	0.77	x	2.6	x	41.38	x	0.63	x	0.7	=	65.76	(75)
Northeast	0.9x	0.77	x	3.15	x	41.38	x	0.63	x	0.7	=	79.67	(75)
Northeast	0.9x	0.77	x	2.6	x	67.96	x	0.63	x	0.7	=	107.99	(75)
Northeast	0.9x	0.77	x	3.15	x	67.96	x	0.63	x	0.7	=	130.84	(75)
Northeast	0.9x	0.77	x	2.6	x	91.35	x	0.63	x	0.7	=	145.17	(75)
Northeast	0.9x	0.77	x	3.15	x	91.35	x	0.63	x	0.7	=	175.87	(75)
Northeast	0.9x	0.77	x	2.6	x	97.38	x	0.63	x	0.7	=	154.76	(75)
Northeast	0.9x	0.77	x	3.15	x	97.38	x	0.63	x	0.7	=	187.5	(75)
Northeast	0.9x	0.77	x	2.6	x	91.1	x	0.63	x	0.7	=	144.78	(75)
Northeast	0.9x	0.77	x	3.15	x	91.1	x	0.63	x	0.7	=	175.4	(75)
Northeast	0.9x	0.77	x	2.6	x	72.63	x	0.63	x	0.7	=	115.42	(75)
Northeast	0.9x	0.77	x	3.15	x	72.63	x	0.63	x	0.7	=	139.83	(75)
Northeast	0.9x	0.77	x	2.6	x	50.42	x	0.63	x	0.7	=	80.13	(75)
Northeast	0.9x	0.77	x	3.15	x	50.42	x	0.63	x	0.7	=	97.08	(75)
Northeast	0.9x	0.77	x	2.6	x	28.07	x	0.63	x	0.7	=	44.6	(75)
Northeast	0.9x	0.77	x	3.15	x	28.07	x	0.63	x	0.7	=	54.04	(75)
Northeast	0.9x	0.77	x	2.6	x	14.2	x	0.63	x	0.7	=	22.56	(75)
Northeast	0.9x	0.77	x	3.15	x	14.2	x	0.63	x	0.7	=	27.33	(75)
Northeast	0.9x	0.77	x	2.6	x	9.21	x	0.63	x	0.7	=	14.64	(75)
Northeast	0.9x	0.77	x	3.15	x	9.21	x	0.63	x	0.7	=	17.74	(75)
Southwest	0.9x	0.77	x	4.39	x	36.79		0.63	x	0.7	=	49.36	(79)
Southwest	0.9x	0.77	x	0.52	x	36.79		0.63	x	0.7	=	5.85	(79)
Southwest	0.9x	0.77	x	4.39	x	62.67		0.63	x	0.7	=	84.09	(79)
Southwest	0.9x	0.77	x	0.52	x	62.67		0.63	x	0.7	=	9.96	(79)
Southwest	0.9x	0.77	x	4.39	x	85.75		0.63	x	0.7	=	115.05	(79)
Southwest	0.9x	0.77	x	0.52	x	85.75		0.63	x	0.7	=	13.63	(79)
Southwest	0.9x	0.77	x	4.39	x	106.25		0.63	x	0.7	=	142.55	(79)
Southwest	0.9x	0.77	x	0.52	x	106.25		0.63	x	0.7	=	16.89	(79)
Southwest	0.9x	0.77	x	4.39	x	119.01		0.63	x	0.7	=	159.67	(79)
Southwest	0.9x	0.77	x	0.52	x	119.01		0.63	x	0.7	=	18.91	(79)
Southwest	0.9x	0.77	x	4.39	x	118.15		0.63	x	0.7	=	158.51	(79)
Southwest	0.9x	0.77	x	0.52	x	118.15		0.63	x	0.7	=	18.78	(79)
Southwest	0.9x	0.77	x	4.39	x	113.91		0.63	x	0.7	=	152.83	(79)
Southwest	0.9x	0.77	x	0.52	x	113.91		0.63	x	0.7	=	18.1	(79)
Southwest	0.9x	0.77	x	4.39	x	104.39		0.63	x	0.7	=	140.05	(79)

Southwest	0.9x	0.77	x	0.52	x	104.39	0.63	x	0.7	=	16.59	(79)
Southwest	0.9x	0.77	x	4.39	x	92.85	0.63	x	0.7	=	124.57	(79)
Southwest	0.9x	0.77	x	0.52	x	92.85	0.63	x	0.7	=	14.76	(79)
Southwest	0.9x	0.77	x	4.39	x	69.27	0.63	x	0.7	=	92.93	(79)
Southwest	0.9x	0.77	x	0.52	x	69.27	0.63	x	0.7	=	11.01	(79)
Southwest	0.9x	0.77	x	4.39	x	44.07	0.63	x	0.7	=	59.13	(79)
Southwest	0.9x	0.77	x	0.52	x	44.07	0.63	x	0.7	=	7	(79)
Southwest	0.9x	0.77	x	4.39	x	31.49	0.63	x	0.7	=	42.25	(79)
Southwest	0.9x	0.77	x	0.52	x	31.49	0.63	x	0.7	=	5	(79)

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

(83)m=	94.87	174.76	274.1	398.27	499.62	519.55	491.11	411.89	316.54	202.58	116.03	79.63	(83)

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

(84)m=	469.78	547.04	632.76	735.33	814.79	813.55	771.71	698.94	614.94	522.79	461.2	443.67	(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	0.86	0.7	0.54	0.61	0.86	0.98	1	1	(86)

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

(87)m=	19.57	19.74	20.03	20.42	20.75	20.93	20.98	20.97	20.82	20.39	19.91	19.54	(87)

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

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

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

(89)m=	1	0.99	0.98	0.94	0.81	0.6	0.41	0.47	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=	17.95	18.19	18.61	19.17	19.61	19.82	19.85	19.85	19.72	19.14	18.45	17.91	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	18.36	18.58	18.97	19.49	19.9	20.1	20.14	20.14	20	19.46	18.82	18.32	(92)

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

(93)m=	18.36	18.58	18.97	19.49	19.9	20.1	20.14	20.14	20	19.46	18.82	18.32	(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	0.62	0.44	0.51	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	467.57	541.78	617.72	683.83	664.23	505.26	339.32	353.71	487.53	501.26	457.01	442.05	(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=	1396.92	1356.75	1234.12	1038.16	802.78	534.14	343.89	362.23	574.39	867.24	1151.19	1392.33	(97)

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

(98)m=	691.44	547.66	458.6	255.12	103.08	0	0	0	0	272.29	499.81	707.01

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3535 (98)

Space heating requirement in kWh/m²/year 46.48 (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)	691.44	547.66	458.6	255.12	103.08	0	0	0	0	272.29	499.81	707.01		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	740.3	586.36	491.01	273.15	110.37	0	0	0	0	291.53	535.13	756.97		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3784.8	(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)	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38		
Efficiency of water heater													80.3	(216)
(217)m=	87.93	87.74	87.29	86.21	84.05	80.3	80.3	80.3	80.3	86.26	87.49	88.01		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	226.38	198.17	207.24	186.12	184.84	170.39	163.25	181.98	183.99	195.04	205.27	220.85		
Total = Sum(219a)$_{1...12}$ =													2323.54	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3784.8	
Water heating fuel used			2323.54	
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			332.6	(232)

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

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

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Space heating (main system 1)	(211) x	0.216	=	817.52	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	501.88	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1319.4	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	172.62	(268)
Total CO2, kg/year		sum of (265)…(271) =		1530.94	(272)

TER =	20.13	(273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	54.34	(1a) x	2.6	(2a) =	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		141.28	(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) =	0.14	(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)	0.39	(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) =	0.33	(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

0.42	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.37	0.39

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

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

(25)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(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			2.6	x	1	=	2.6			(26)
Windows Type 1			4.56	x1/[1/(1.4)+ 0.04]		=	6.05			(27)
Windows Type 2			1.4	x1/[1/(1.4)+ 0.04]		=	1.86			(27)
Windows Type 3			0.48	x1/[1/(1.4)+ 0.04]		=	0.64			(27)
Walls Type1	59.86	11	48.86	x	0.18	=	8.79			(29)
Walls Type2	24.47	2.6	21.87	x	0.18	=	3.94			(29)
Walls Type3	2.57	0	2.57	x	0.18	=	0.46			(29)
Roof	54.34	0	54.34	x	0.13	=	7.06			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 37.44 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18919.46 (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 25.93 (36)

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

Total fabric heat loss (33) + (36) = 63.37 (37)

TER WorkSheet: New dwelling design stage

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=	27.51	27.35	27.19	26.44	26.3	25.64	25.64	25.52	25.89	26.3	26.58	26.88	(38)

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

(39)m=	90.88	90.71	90.55	89.8	89.66	89.01	89.01	88.89	89.26	89.66	89.95	90.24	

Average = $Sum(39)_{1...12}$ /12= 89.8 (39)

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

(40)m=	1.67	1.67	1.67	1.65	1.65	1.64	1.64	1.64	1.64	1.65	1.66	1.66	

Average = $Sum(40)_{1...12}$ /12= 1.65 (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 1.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12	

Total = $Sum(44)_{1...12}$ = 928.53 (44)

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

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24	

Total = $Sum(45)_{1...12}$ = 1217.45 (45)

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

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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=	43.37	37.75	40.22	37.4	37.06	34.34	35.49	37.06	37.4	40.22	40.45	43.37	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61

Output from water heater (annual)$_{1...12}$ — 1681.59 (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=	52.81	46.14	47.93	42.37	40.95	35.93	34.21	38.34	38.77	44.34	47.54	51.49	(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=	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.21	12.62	10.27	7.77	5.81	4.9	5.3	6.89	9.25	11.74	13.7	14.61	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	158.48	160.13	155.98	147.16	136.02	125.56	118.56	116.92	121.06	129.89	141.02	151.49	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)
Water heating gains (Table 5)													
(72)m=	70.98	68.67	64.43	58.85	55.04	49.9	45.98	51.53	53.85	59.6	66.03	69.2	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	296.95	294.69	283.94	267.05	250.15	233.63	223.11	228.61	237.43	254.5	274.02	288.57	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast 0.9x	0.77	x	4.56	x	11.28	x	0.63	x	0.7	=	31.45	(75)
Northeast 0.9x	0.77	x	4.56	x	22.97	x	0.63	x	0.7	=	64.01	(75)
Northeast 0.9x	0.77	x	4.56	x	41.38	x	0.63	x	0.7	=	115.33	(75)
Northeast 0.9x	0.77	x	4.56	x	67.96	x	0.63	x	0.7	=	189.41	(75)
Northeast 0.9x	0.77	x	4.56	x	91.35	x	0.63	x	0.7	=	254.6	(75)
Northeast 0.9x	0.77	x	4.56	x	97.38	x	0.63	x	0.7	=	271.43	(75)
Northeast 0.9x	0.77	x	4.56	x	91.1	x	0.63	x	0.7	=	253.92	(75)
Northeast 0.9x	0.77	x	4.56	x	72.63	x	0.63	x	0.7	=	202.43	(75)
Northeast 0.9x	0.77	x	4.56	x	50.42	x	0.63	x	0.7	=	140.53	(75)
Northeast 0.9x	0.77	x	4.56	x	28.07	x	0.63	x	0.7	=	78.23	(75)
Northeast 0.9x	0.77	x	4.56	x	14.2	x	0.63	x	0.7	=	39.57	(75)
Northeast 0.9x	0.77	x	4.56	x	9.21	x	0.63	x	0.7	=	25.68	(75)
Southwest 0.9x	0.77	x	1.4	x	36.79		0.63	x	0.7	=	15.74	(79)
Southwest 0.9x	0.77	x	0.48	x	36.79		0.63	x	0.7	=	5.4	(79)
Southwest 0.9x	0.77	x	1.4	x	62.67		0.63	x	0.7	=	26.82	(79)
Southwest 0.9x	0.77	x	0.48	x	62.67		0.63	x	0.7	=	9.19	(79)
Southwest 0.9x	0.77	x	1.4	x	85.75		0.63	x	0.7	=	36.69	(79)
Southwest 0.9x	0.77	x	0.48	x	85.75		0.63	x	0.7	=	12.58	(79)
Southwest 0.9x	0.77	x	1.4	x	106.25		0.63	x	0.7	=	45.46	(79)
Southwest 0.9x	0.77	x	0.48	x	106.25		0.63	x	0.7	=	15.59	(79)
Southwest 0.9x	0.77	x	1.4	x	119.01		0.63	x	0.7	=	50.92	(79)
Southwest 0.9x	0.77	x	0.48	x	119.01		0.63	x	0.7	=	17.46	(79)
Southwest 0.9x	0.77	x	1.4	x	118.15		0.63	x	0.7	=	50.55	(79)
Southwest 0.9x	0.77	x	0.48	x	118.15		0.63	x	0.7	=	17.33	(79)
Southwest 0.9x	0.77	x	1.4	x	113.91		0.63	x	0.7	=	48.74	(79)
Southwest 0.9x	0.77	x	0.48	x	113.91		0.63	x	0.7	=	16.71	(79)
Southwest 0.9x	0.77	x	1.4	x	104.39		0.63	x	0.7	=	44.66	(79)
Southwest 0.9x	0.77	x	0.48	x	104.39		0.63	x	0.7	=	15.31	(79)
Southwest 0.9x	0.77	x	1.4	x	92.85		0.63	x	0.7	=	39.73	(79)
Southwest 0.9x	0.77	x	0.48	x	92.85		0.63	x	0.7	=	13.62	(79)
Southwest 0.9x	0.77	x	1.4	x	69.27		0.63	x	0.7	=	29.64	(79)
Southwest 0.9x	0.77	x	0.48	x	69.27		0.63	x	0.7	=	10.16	(79)
Southwest 0.9x	0.77	x	1.4	x	44.07		0.63	x	0.7	=	18.86	(79)
Southwest 0.9x	0.77	x	0.48	x	44.07		0.63	x	0.7	=	6.46	(79)
Southwest 0.9x	0.77	x	1.4	x	31.49		0.63	x	0.7	=	13.47	(79)
Southwest 0.9x	0.77	x	0.48	x	31.49		0.63	x	0.7	=	4.62	(79)

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

(83)m=	52.59	100.02	164.6	250.45	322.98	339.31	319.36	262.4	193.88	118.03	64.89	43.77	(83)

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

(84)m=	349.54	394.71	448.54	517.5	573.12	572.94	542.48	491.01	431.31	372.52	338.91	332.34	(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

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(86)m=	1	0.99	0.99	0.97	0.91	0.79	0.65	0.72	0.91	0.98	0.99	1	(86)

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

(87)m=	19.15	19.31	19.63	20.07	20.51	20.81	20.94	20.91	20.64	20.1	19.55	19.13	(87)

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

(88)m=	19.56	19.56	19.56	19.57	19.58	19.59	19.59	19.59	19.58	19.58	19.57	19.57	(88)

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

(89)m=	1	0.99	0.98	0.95	0.87	0.68	0.47	0.55	0.84	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=	17.16	17.39	17.85	18.5	19.09	19.46	19.56	19.55	19.29	18.55	17.75	17.12	(90)

fLA = Living area ÷ (4) = 0.25 (91)

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

(92)m=	17.66	17.87	18.29	18.89	19.44	19.8	19.91	19.89	19.63	18.94	18.2	17.62	(92)

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

(93)m=	17.66	17.87	18.29	18.89	19.44	19.8	19.91	19.89	19.63	18.94	18.2	17.62	(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	0.94	0.86	0.7	0.52	0.59	0.84	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	347.25	390.43	438.57	488.38	493.07	401.72	280.7	288.14	363.16	358.84	335.19	330.54	(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=	1213.97	1176.85	1067.91	897.15	694.28	462.86	294.4	310.22	493.21	747.49	998.66	1211.5	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	644.84	528.47	468.23	294.31	149.71	0	0	0	0	289.16	477.7	655.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3507.84 (98)

Space heating requirement in kWh/m²/year 64.55 (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)													
	644.84	528.47	468.23	294.31	149.71	0	0	0	0	289.16	477.7	655.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	690.41	565.81	501.32	315.1	160.28	0	0	0	0	309.59	511.45	701.75	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3755.71 (211)

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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)

169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61

Efficiency of water heater 80.3 (216)

(217)m=	88.09	87.98	87.67	86.93	85.36	80.3	80.3	80.3	80.3	86.78	87.72	88.16	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	192.52	168.39	175.82	157.26	155.06	145.18	139.09	155.05	156.77	165.17	174.43	187.85

Total = Sum(219a)$_{1...12}$ = 1972.6 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3755.71	
Water heating fuel used		1972.6	
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		250.97	(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	=	811.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	426.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1237.31	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	130.26	(268)
Total CO2, kg/year		sum of (265)…(271) =		1406.5	(272)

TER = 25.88 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.59	(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) =	0.14	(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)	0.39	(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) =	0.3	(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

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

0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.3	0.32	0.34	0.35

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

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

(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	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			2.6	x	1	=	2.6			(26)
Windows Type 1			4.69	x1/[1/(1.4)+ 0.04]		=	6.22			(27)
Windows Type 2			1.44	x1/[1/(1.4)+ 0.04]		=	1.91			(27)
Windows Type 3			0.49	x1/[1/(1.4)+ 0.04]		=	0.65			(27)
Walls Type1	34.66	11.31	23.35	x	0.18	=	4.2			(29)
Walls Type2	23.92	2.6	21.32	x	0.18	=	3.84			(29)
Walls Type3	2.63	0	2.63	x	0.18	=	0.47			(29)
Walls Type4	25.13	0	25.13	x	0.18	=	4.52			(29)
Roof	55.61	0	55.61	x	0.13	=	7.23			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 37.86 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 18867.19 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 25.88 (36)

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

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Total fabric heat loss (33) + (36) = 63.74 (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=	27.37	27.23	27.1	26.47	26.35	25.81	25.81	25.71	26.02	26.35	26.59	26.84	(38)

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

(39)m=	91.11	90.97	90.84	90.21	90.09	89.54	89.54	89.44	89.76	90.09	90.33	90.58	

Average = $Sum(39)_{1...12}$ /12= 90.21 (39)

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

(40)m=	1.64	1.64	1.63	1.62	1.62	1.61	1.61	1.61	1.61	1.62	1.62	1.63	

Average = $Sum(40)_{1...12}$ /12= 1.62 (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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09	

Total = $Sum(44)_{1...12}$ = 939.13 (44)

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

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64	

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

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

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	43.87	38.18	40.68	37.82	37.49	34.74	35.89	37.49	37.82	40.68	40.91	43.87	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51

Output from water heater (annual)1…12 1700.79 (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=	53.42	46.67	48.48	42.86	41.42	36.34	34.6	38.78	39.21	44.85	48.08	52.08	(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=	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	(66)

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

(67)m=	14.5	12.88	10.47	7.93	5.93	5	5.41	7.03	9.43	11.98	13.98	14.9	(67)

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

(68)m=	161.76	163.43	159.2	150.2	138.83	128.15	121.01	119.33	123.56	132.57	143.94	154.62	(68)

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

(69)m=	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	71.8	69.45	65.16	59.52	55.67	50.47	46.51	52.12	54.46	60.28	66.78	70	(72)

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

(73)m=	301.88	299.59	288.67	271.48	254.26	237.45	226.75	232.31	241.29	258.66	278.52	293.34	(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	4.69	x	11.28	x	0.63	x	0.7	=	32.34	(75)
Northeast	0.9x	0.77	x	4.69	x	22.97	x	0.63	x	0.7	=	65.84	(75)
Northeast	0.9x	0.77	x	4.69	x	41.38	x	0.63	x	0.7	=	118.62	(75)
Northeast	0.9x	0.77	x	4.69	x	67.96	x	0.63	x	0.7	=	194.81	(75)
Northeast	0.9x	0.77	x	4.69	x	91.35	x	0.63	x	0.7	=	261.86	(75)
Northeast	0.9x	0.77	x	4.69	x	97.38	x	0.63	x	0.7	=	279.17	(75)
Northeast	0.9x	0.77	x	4.69	x	91.1	x	0.63	x	0.7	=	261.16	(75)
Northeast	0.9x	0.77	x	4.69	x	72.63	x	0.63	x	0.7	=	208.2	(75)
Northeast	0.9x	0.77	x	4.69	x	50.42	x	0.63	x	0.7	=	144.54	(75)
Northeast	0.9x	0.77	x	4.69	x	28.07	x	0.63	x	0.7	=	80.46	(75)
Northeast	0.9x	0.77	x	4.69	x	14.2	x	0.63	x	0.7	=	40.7	(75)
Northeast	0.9x	0.77	x	4.69	x	9.21	x	0.63	x	0.7	=	26.41	(75)
Southwest	0.9x	0.77	x	1.44	x	36.79		0.63	x	0.7	=	16.19	(79)
Southwest	0.9x	0.77	x	0.49	x	36.79		0.63	x	0.7	=	5.51	(79)
Southwest	0.9x	0.77	x	1.44	x	62.67		0.63	x	0.7	=	27.58	(79)
Southwest	0.9x	0.77	x	0.49	x	62.67		0.63	x	0.7	=	9.39	(79)
Southwest	0.9x	0.77	x	1.44	x	85.75		0.63	x	0.7	=	37.74	(79)
Southwest	0.9x	0.77	x	0.49	x	85.75		0.63	x	0.7	=	12.84	(79)
Southwest	0.9x	0.77	x	1.44	x	106.25		0.63	x	0.7	=	46.76	(79)
Southwest	0.9x	0.77	x	0.49	x	106.25		0.63	x	0.7	=	15.91	(79)
Southwest	0.9x	0.77	x	1.44	x	119.01		0.63	x	0.7	=	52.37	(79)
Southwest	0.9x	0.77	x	0.49	x	119.01		0.63	x	0.7	=	17.82	(79)
Southwest	0.9x	0.77	x	1.44	x	118.15		0.63	x	0.7	=	52	(79)
Southwest	0.9x	0.77	x	0.49	x	118.15		0.63	x	0.7	=	17.69	(79)
Southwest	0.9x	0.77	x	1.44	x	113.91		0.63	x	0.7	=	50.13	(79)
Southwest	0.9x	0.77	x	0.49	x	113.91		0.63	x	0.7	=	17.06	(79)
Southwest	0.9x	0.77	x	1.44	x	104.39		0.63	x	0.7	=	45.94	(79)
Southwest	0.9x	0.77	x	0.49	x	104.39		0.63	x	0.7	=	15.63	(79)
Southwest	0.9x	0.77	x	1.44	x	92.85		0.63	x	0.7	=	40.86	(79)
Southwest	0.9x	0.77	x	0.49	x	92.85		0.63	x	0.7	=	13.9	(79)
Southwest	0.9x	0.77	x	1.44	x	69.27		0.63	x	0.7	=	30.48	(79)
Southwest	0.9x	0.77	x	0.49	x	69.27		0.63	x	0.7	=	10.37	(79)
Southwest	0.9x	0.77	x	1.44	x	44.07		0.63	x	0.7	=	19.39	(79)
Southwest	0.9x	0.77	x	0.49	x	44.07		0.63	x	0.7	=	6.6	(79)
Southwest	0.9x	0.77	x	1.44	x	31.49		0.63	x	0.7	=	13.86	(79)
Southwest	0.9x	0.77	x	0.49	x	31.49		0.63	x	0.7	=	4.72	(79)

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

(83)m=	54.05	102.8	169.2	257.48	332.05	348.86	328.34	269.77	199.31	121.32	66.69	44.99	(83)

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

(84)m=	355.92	402.4	457.87	528.95	586.31	586.31	555.09	502.08	440.59	379.97	345.22	338.33	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.97	0.91	0.79	0.64	0.71	0.9	0.98	0.99	1	(86)

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

(87)m=	19.19	19.35	19.66	20.1	20.52	20.82	20.94	20.91	20.66	20.12	19.58	19.16	(87)

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

(88)m=	19.59	19.59	19.59	19.6	19.6	19.61	19.61	19.61	19.6	19.6	19.6	19.59	(88)

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

(89)m=	1	0.99	0.98	0.95	0.86	0.68	0.47	0.54	0.84	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=	17.23	17.46	17.91	18.55	19.13	19.49	19.59	19.57	19.32	18.59	17.81	17.19	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	17.73	17.94	18.36	18.94	19.49	19.83	19.93	19.92	19.66	18.98	18.26	17.69	(92)

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

(93)m=	17.73	17.94	18.36	18.94	19.49	19.83	19.93	19.92	19.66	18.98	18.26	17.69	(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	0.99	0.98	0.94	0.86	0.7	0.51	0.58	0.84	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.68	398.15	447.8	499.11	503.48	409.12	285.4	293.2	370.53	366.15	341.53	336.57	(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=	1223.61	1186.55	1077.16	906.13	701.61	468.45	298.5	314.53	499.12	755.34	1008.17	1222.18	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	647.23	529.81	468.24	293.06	147.41	0	0	0	0	289.56	479.98	658.89	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = | 3514.18 | (98)

Space heating requirement in kWh/m²/year | 63.19 | (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)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	647.23	529.81	468.24	293.06	147.41	0	0	0	0	289.56	479.98	658.89		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	692.96	567.24	501.33	313.76	157.83	0	0	0	0	310.02	513.9	705.45		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3762.5	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51		
Efficiency of water heater													80.3	(216)
(217)m=	88.08	87.96	87.65	86.9	85.29	80.3	80.3	80.3	80.3	86.76	87.71	88.15		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	194.75	170.35	177.87	159.13	156.96	146.83	140.68	156.82	158.56	167.11	176.45	190.02		
Total = Sum(219a)$_{1...12}$ =													1995.52	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3762.5	
Water heating fuel used			1995.52	
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			256.04	(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	=	812.7	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	431.03	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1243.73	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	132.89	(268)
Total CO2, kg/year			sum of (265)…(271) =		1415.54	(272)

TER = 25.45 (273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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		36.66	(36)

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

Total fabric heat loss	(33) + (36) =	107.78	(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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

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

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = Sum(39)1…12 /12= 133.24 (39)

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

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = Sum(40)1…12 /12= 1.24 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68	

Total = Sum(44)1…12 = 1207.41 (44)

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

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96	

Total = Sum(45)1…12 = 1583.1 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (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=	50.96	46.03	50.96	48.63	48.2	44.66	46.15	48.2	48.63	50.96	49.32	50.96	(61)

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

(62)m=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91	(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=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91

Output from water heater (annual)$_{1...12}$ — 2166.73 (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=	67.31	59.24	61.99	55.1	53.25	46.72	44.48	49.86	50.42	57.33	61	65.59	(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=	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	(66)

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

(67)m=	59.59	52.93	43.05	32.59	24.36	20.57	22.22	28.89	38.77	49.23	57.46	61.25	(67)

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

(68)m=	399.08	403.22	392.78	370.57	342.52	316.16	298.56	294.41	304.85	327.07	355.11	381.47	(68)

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

(69)m=	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

Water heating gains (Table 5)

(72)m=	90.48	88.15	83.33	76.52	71.58	64.89	59.79	67.01	70.02	77.05	84.72	88.16	(72)

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

(73)m=	662.65	657.81	632.66	593.19	551.96	515.12	494.07	503.82	527.15	566.85	610.79	644.39	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

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Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast	0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast	0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast	0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast	0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast	0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast	0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast	0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast	0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast	0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast	0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast	0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast	0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

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

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

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

(84)m=	731.49	782.21	821.85	859.4	879.18	852.74	814.26	776.54	742.7	709.46	694.55	702.46	(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	0.98	0.93	0.82	0.66	0.71	0.9	0.98	0.99	1	(86)

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

(87)m=	19.68	19.8	20.02	20.33	20.64	20.88	20.97	20.95	20.79	20.41	19.99	19.66	(87)

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

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

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

(89)m=	1	0.99	0.99	0.96	0.9	0.73	0.52	0.57	0.84	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=	18.13	18.3	18.62	19.08	19.51	19.81	19.89	19.88	19.71	19.19	18.6	18.11	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.36	18.52	18.83	19.27	19.68	19.97	20.04	20.04	19.87	19.37	18.8	18.34	(92)

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

(93)m=	18.21	18.37	18.68	19.12	19.53	19.82	19.89	19.89	19.72	19.22	18.65	18.19	(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	0.95	0.89	0.73	0.52	0.57	0.83	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	726.03	773.51	805.42	820.54	780.09	619.35	422.75	441.68	613.53	679.63	685.59	698.09	(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=	1884.93	1821.35	1642.61	1361.99	1041.09	685.54	432.95	457.35	742.35	1146.73	1543.62	1877.66	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	862.22	704.15	622.87	389.84	194.18	0	0	0	0	347.52	617.78	877.6	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4616.17 (98)

Space heating requirement in kWh/m²/year 43.09 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	862.22	704.15	622.87	389.84	194.18	0	0	0	0	347.52	617.78	877.6	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	963.38	786.76	695.94	435.58	216.96	0	0	0	0	388.29	690.26	980.56	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5157.73 (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)

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Water heating

Output from water heater (calculated above)

215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	240.33	211.82	222.45	198.63	192.31	169.37	162.27	180.9	182.9	206.77	218.65	234.54

Total = Sum(219a)$_{1...12}$ = 2420.93 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5157.73	
Water heating fuel used		2420.93	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	247.21		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		277.21	(231)
Electricity for lighting		420.97	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	179.49	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	84.25	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	36.56	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	55.53	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 475.83 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.31	(257)
SAP rating (Section 12)		81.68	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	1114.07	(261)

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	522.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1636.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	143.87	(267)
Electricity for lighting	(232) x	0.519	=	218.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		1999.35	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.66	(273)
EI rating (section 14)				82	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	6292.43	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2953.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			9245.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	851.02	(267)
Electricity for lighting	(232) x	0	=	1292.39	(268)
'Total Primary Energy		sum of (265)…(271) =		11389.38	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		106.3	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.15	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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

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

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86		(38)
Heat transfer coefficient, W/K (39)m = (37) + (38)m														
(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37		
									Average = Sum(39)1…12 /12=				133.41	(39)
Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)														
(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	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	2.82	(42)

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

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	101.09	(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2		
									Total = Sum(44)1…12 =				1213.1	(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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7		
									Total = Sum(45)1…12 =				1590.57	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96		(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (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=	50.96	46.03	50.96	48.86	48.42	44.87	46.36	48.42	48.86	50.96	49.32	50.96	(61)

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

(62)m=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66	(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=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66

Output from water heater (annual)$_{1...12}$ — 2175.54 (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=	67.57	59.46	62.23	55.36	53.5	46.94	44.69	50.09	50.65	57.54	61.23	65.84	(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=	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	60.61	53.84	43.78	33.15	24.78	20.92	22.6	29.38	39.43	50.07	58.44	62.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	405.91	410.12	399.5	376.91	348.38	321.58	303.67	299.45	310.07	332.66	361.19	388	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

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Water heating gains (Table 5)

(72)m=	90.82	88.49	83.64	76.89	71.91	65.19	60.07	67.33	70.35	77.33	85.04	88.5	(72)

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

(73)m=	671.39	666.49	640.97	600.99	559.12	521.73	500.39	510.21	533.9	574.11	618.71	652.84	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest	0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest	0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest	0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest	0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest	0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest	0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest	0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest	0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest	0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

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

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

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

(84)m=	729.8	774.67	812.03	851.55	875.03	850.86	811.25	769.95	732.12	699.89	690.26	701.81	(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	0.98	0.94	0.83	0.67	0.72	0.91	0.98	0.99	1	(86)

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

(87)m=	19.71	19.82	20.03	20.34	20.65	20.88	20.97	20.96	20.79	20.41	20.01	19.69	(87)

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

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

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

(89)m=	1	0.99	0.99	0.97	0.91	0.74	0.53	0.58	0.85	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=	18.19	18.35	18.66	19.12	19.54	19.84	19.91	19.91	19.74	19.22	18.64	18.17	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.4	18.56	18.86	19.29	19.7	19.98	20.06	20.05	19.89	19.39	18.83	18.38	(92)

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

(93)m=	18.25	18.41	18.71	19.14	19.55	19.83	19.91	19.9	19.74	19.24	18.68	18.23	(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	0.96	0.89	0.73	0.53	0.58	0.84	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	725	767.19	797.81	816.58	781.55	623.34	426.05	444.74	612.64	673.65	682.4	697.96	(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=	1891.71	1827.01	1647.32	1366.7	1045.34	689.42	436.08	460.54	745.62	1150.73	1549.8	1885.51	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	868.03	712.2	632.03	396.08	196.26	0	0	0	0	354.95	624.53	883.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4667.62 (98)

Space heating requirement in kWh/m²/year 42.33 (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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	868.03	712.2	632.03	396.08	196.26	0	0	0	0	354.95	624.53	883.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	969.87	795.75	706.18	442.55	219.29	0	0	0	0	396.59	697.8	987.2	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 5215.22 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

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

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

SAP WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	241.19	212.58	223.23	199.57	193.22	170.17	163.04	181.75	183.76	207.47	219.42	235.38

Total = Sum(219a)$_{1...12}$ = 2430.77 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		5215.22	
Water heating fuel used		2430.77	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	253.98		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		283.98	(231)
Electricity for lighting		428.18	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	181.49	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	84.59	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	37.46	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	56.48	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 480.01 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.3	(257)
SAP rating (Section 12)		81.89	(258)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	1126.49	(261)

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	525.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1651.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	147.38	(267)
Electricity for lighting	(232) x	0.519	=	222.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		2021.14	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.33	(273)
EI rating (section 14)				83	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	6362.57	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2965.54	(264)
Space and water heating	(261) + (262) + (263) + (264) =			9328.11	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	871.81	(267)
Electricity for lighting	(232) x	0	=	1314.51	(268)
'Total Primary Energy		sum of (265)…(271) =		11514.43	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		104.41	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27754.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.19 (36)

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

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = $Sum(39)_{1...12}$ /12= 74.07 (39)

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

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)1…12 | 1951.28 | (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	537.94	533.3	512.68	480.96	448.52	419.26	402.39	410.78	429.16	461.08	496.57	523.55	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	583.27	616.8	643.65	671.25	687.23	667.49	637.02	607.57	580.4	557.88	552.01	561.6	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.85	0.67	0.5	0.54	0.79	0.95	0.99	0.99	(86)

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

(87)m=	20.11	20.22	20.4	20.66	20.86	20.97	21	20.99	20.94	20.69	20.36	20.09	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

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

(89)m=	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.44	0.71	0.93	0.98	0.99	(89)

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

(90)m=	18.9	19.05	19.32	19.68	19.95	20.08	20.09	20.1	20.04	19.73	19.27	18.88	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.22	19.36	19.6	19.94	20.19	20.31	20.33	20.33	20.28	19.98	19.56	19.2	(92)

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

(93)m=	19.07	19.21	19.45	19.79	20.04	20.16	20.18	20.18	20.13	19.83	19.41	19.05	(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	0.92	0.8	0.59	0.41	0.45	0.72	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	575.49	604.58	620.24	614.42	549.65	395.98	260.12	273.28	415.05	513.6	538.69	555.35	(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=	1115.51	1077.7	973.13	806.99	616.67	405.61	261.07	274.9	441.77	682.57	914.78	1109.31	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	401.77	317.93	262.55	138.65	49.87	0	0	0	0	125.71	270.79	412.14		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													1979.42	(98)
Space heating requirement in kWh/m²/year													26.73	(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	685.27	539.47	552.51	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.86	0.93	0.9	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	591.68	500.37	499.94	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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	82.6	128.91	102.56	0	0	0	0		
Total = Sum(104)$_{6...8}$ =													314.07	(104)
Cooled fraction — f C = cooled area ÷ (4) =													0.6	(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	12.41	19.36	15.41	0	0	0	0		
Total = Sum(107)$_{6...8}$ =													47.18	(107)
Space cooling requirement in kWh/m²/year — (107) ÷ (4) =													0.64	(108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	401.77	317.93	262.55	138.65	49.87	0	0	0	0	125.71	270.79	412.14		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	448.91	355.23	293.35	154.92	55.72	0	0	0	0	140.46	302.56	460.5		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2211.65	(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)

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Water heating

Output from water heater (calculated above)

196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72

Total = $Sum(219a)_{1...12}$ = 2180.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.63	4.1	3.26	0	0	0	0

Total = $Sum(221)_{6...8}$ = 9.98 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2211.65	
Water heating fuel used		2180.21	
Space cooling fuel used		9.98	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	158.57		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		188.57	(231)
Electricity for lighting		325.25	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	76.97	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.87	(247)
Space cooling	(221)	13.19	x 0.01 =	1.32	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	24.87	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.9	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 341.93 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.21	(257)

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SAP rating (Section 12) 83.17 (258)

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

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	477.72	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =				948.64	(265)
Space cooling	(221)	x	0.519	=	5.18	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	97.87	(267)
Electricity for lighting	(232)	x	0.519	=	168.8	(268)
Total CO2, kg/year			sum of (265)…(271) =		1220.49	(272)
CO2 emissions per m²			(272) ÷ (4) =		16.48	(273)
EI rating (section 14)					86	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2698.21	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2659.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =				5358.06	(265)
Space cooling	(221)	x	3.07	=	30.65	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	578.91	(267)
Electricity for lighting	(232)	x	0	=	998.51	(268)
‘Total Primary Energy			sum of (265)…(271) =		6966.13	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		94.06	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) = 39.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27990.6 (34)

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

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	18.24	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)		
Total fabric heat loss (33) + (36) =	57.66	(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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24	

Average = Sum(39)$_{1...12}$ /12= 73.62 (39)

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

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98	

Average = Sum(40)$_{1...12}$ /12= 0.97 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1...12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	

Output from water heater (annual)$_{1...12}$ 1973.65 (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	547.65	542.94	521.92	489.59	456.5	426.67	409.48	417.99	436.74	469.28	505.45	532.97	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	592.98	626.44	652.89	679.88	695.21	674.9	644.12	614.78	587.98	566.07	560.89	571.02	(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	0.98	0.94	0.85	0.66	0.49	0.53	0.78	0.95	0.99	0.99	(86)

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

(87)m=	20.15	20.25	20.43	20.68	20.88	20.98	21	20.99	20.94	20.71	20.4	20.13	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

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

(89)m=	0.99	0.98	0.97	0.92	0.8	0.58	0.4	0.44	0.71	0.93	0.98	0.99	(89)

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

(90)m=	18.98	19.13	19.39	19.74	19.99	20.11	20.12	20.12	20.07	19.79	19.34	18.96	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.28	19.42	19.65	19.98	20.22	20.33	20.34	20.34	20.3	20.02	19.61	19.26	(92)

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

(93)m=	19.13	19.27	19.5	19.83	20.07	20.18	20.19	20.19	20.15	19.87	19.46	19.11	(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	0.91	0.8	0.59	0.4	0.44	0.71	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	585.16	614.1	629.08	621.51	553.27	396.34	259.94	273.19	416.9	520.34	547.36	564.77	(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=	1112.31	1074.65	970.4	805.04	615	404.71	260.72	274.54	440.83	681.25	912.88	1106.68	(97)

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

(98)m=	392.2	309.49	253.94	132.14	45.93	0	0	0	0	119.72	263.18	403.19

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1919.77 (98)

Space heating requirement in kWh/m²/year 25.24 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	595.19	501.61	502.07	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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	85.4	133.26	106.34	0	0	0	0

Total = Sum(104)$_{6...8}$ = 325.01 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	12.49	19.49	15.55	0	0	0	0

Total = Sum(107)$_{6...8}$ = 47.54 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.63 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	392.2	309.49	253.94	132.14	45.93	0	0	0	0	119.72	263.18	403.19	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	438.21	345.8	283.73	147.64	51.31	0	0	0	0	133.77	294.05	450.49	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2145 (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)

199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Efficiency of water heater: 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18

Total = Sum(219a)$_{1...12}$ = 2205.19 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.64	4.13	3.29	0	0	0	0

Total = Sum(221)$_{6...8}$ = 10.06 (221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2145	
Water heating fuel used			2205.19	
Space cooling fuel used			10.06	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		162.85		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting			332.22	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	74.65	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	76.74	(247)
Space cooling	(221)	13.19	x 0.01 =	1.33	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	25.44	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.82	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 341.97 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.19	(257)

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SAP rating (Section 12)				83.45	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	463.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			939.64	(265)
Space cooling	(221) x	0.519	=	5.22	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	100.09	(267)
Electricity for lighting	(232) x	0.519	=	172.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1217.38	(272)
CO2 emissions per m²		(272) ÷ (4) =		16.01	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2616.9	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2690.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5307.24	(265)
Space cooling	(221) x	3.07	=	30.89	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	592.06	(267)
Electricity for lighting	(232) x	0	=	1019.91	(268)
‘Total Primary Energy		sum of (265)…(271) =		6950.09	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		91.38	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) =	76.5	(23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) =	37.93	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	27828.4	(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	11.04	(36)

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

SAP WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 48.97 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = Sum(39)$_{1...12}$ /12= 65.3 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = Sum(40)$_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = Sum(44)$_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = Sum(45)$_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

SAP 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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	

Output from water heater (annual)$_{1...12}$ | 1951.28 | (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	537.94	533.3	512.68	480.96	448.52	419.26	402.39	410.78	429.16	461.08	496.57	523.55	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	583.27	616.8	643.65	671.25	687.23	667.49	637.02	607.57	580.4	557.88	552.01	561.6	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.8	0.6	0.44	0.48	0.73	0.93	0.98	0.99	(86)

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

(87)m=	20.29	20.38	20.55	20.77	20.93	20.99	21	21	20.97	20.79	20.51	20.27	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.9	0.75	0.53	0.36	0.4	0.66	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=	19.23	19.37	19.61	19.92	20.12	20.19	20.2	20.2	20.17	19.95	19.56	19.21	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.5	19.63	19.86	20.14	20.33	20.4	20.41	20.41	20.38	20.17	19.81	19.48	(92)

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

(93)m=	19.35	19.48	19.71	19.99	20.18	20.25	20.26	20.26	20.23	20.02	19.66	19.33	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.89	0.75	0.54	0.37	0.41	0.66	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	574.4	602.43	615.04	599.35	517.71	358.89	234.26	246.17	383.66	502.03	536.04	554.54	(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=	1005.19	970.84	876.43	725	552.42	362.36	234.52	246.65	395.59	613.81	823.19	998.22	(97)

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

(98)m=	320.5	247.57	194.48	90.47	25.83	0	0	0	0	83.16	206.75	330.1

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1498.86 (98)

Space heating requirement in kWh/m²/year 20.24 (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	602.87	474.6	485.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.92	0.97	0.95	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	555.88	458.15	462.2	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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	108.37	160.32	130.65	0	0	0	0

Total = Sum(104)$_{6...8}$ = 399.33 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	16.28	24.08	19.63	0	0	0	0

Total = Sum(107)$_{6...8}$ = 59.99 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.81 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	320.5	247.57	194.48	90.47	25.83	0	0	0	0	83.16	206.75	330.1	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	358.1	276.62	217.29	101.08	28.85	0	0	0	0	92.91	231	368.83	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1674.7 (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)

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Water heating

Output from water heater (calculated above)

196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72

Total = Sum(219a)$_{1...12}$ = 2180.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	3.45	5.1	4.15	0	0	0	0

Total = Sum(221)$_{6...8}$ = 12.7 (221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1674.7	
Water heating fuel used			2180.21	
Space cooling fuel used			12.7	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		158.57		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		188.57	(231)
Electricity for lighting			325.25	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	58.28	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.87	(247)
Space cooling	(221)	13.19	x 0.01 =	1.67	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	24.87	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.9	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 323.6 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12) 0.42 (256)

Energy cost factor (ECF) [(255) x (256)] ÷ [(4) + 45.0] = 1.14 (257)

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SAP rating (Section 12)				84.08	(258)

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

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	361.74	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			832.66	(265)
Space cooling	(221) x	0.519	=	6.59	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.87	(267)
Electricity for lighting	(232) x	0.519	=	168.8	(268)
Total CO2, kg/year		sum of (265)…(271) =		1105.92	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.93	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2043.14	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2659.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4702.99	(265)
Space cooling	(221) x	3.07	=	38.98	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	578.91	(267)
Electricity for lighting	(232) x	0	=	998.51	(268)
‘Total Primary Energy		sum of (265)…(271) =		6319.39	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		85.33	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) = 37.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28062.4 (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 (36)

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

Total fabric heat loss (33) + (36) = **48.84** (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = Sum(39)1…12 /12= **64.8** (39)

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

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86

Average = Sum(40)1…12 /12= **0.85** (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 **2.38** (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 **90.82** (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)1…12 = **1089.8** (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)1…12 = **1428.9** (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Output from water heater (annual)$_{1...12}$ | 1973.65 | (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	547.65	542.94	521.92	489.59	456.5	426.67	409.48	417.99	436.74	469.28	505.45	532.97	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	592.98	626.44	652.89	679.88	695.21	674.9	644.12	614.78	587.98	566.07	560.89	571.02	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.8	0.6	0.43	0.47	0.72	0.93	0.98	0.99	(86)

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

(87)m=	20.33	20.42	20.58	20.79	20.94	20.99	21	21	20.97	20.81	20.54	20.31	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.99	0.98	0.96	0.9	0.75	0.53	0.36	0.39	0.65	0.9	0.98	0.99	(89)

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

(90)m=	19.31	19.44	19.67	19.97	20.15	20.22	20.22	20.22	20.2	20	19.62	19.28	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.57	19.69	19.91	20.18	20.35	20.41	20.42	20.42	20.4	20.21	19.86	19.54	(92)

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

(93)m=	19.42	19.54	19.76	20.03	20.2	20.26	20.27	20.27	20.25	20.06	19.71	19.39	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.95	0.89	0.75	0.53	0.36	0.4	0.65	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	583.92	611.68	623.29	604.99	519.07	358.02	233.59	245.51	383.77	507.55	544.38	563.84	(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=	1000.37	966.23	872.27	721.8	549.74	360.87	233.79	245.87	393.92	611.4	819.94	994	(97)

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

(98)m=	309.84	238.26	185.24	84.1	22.82	0	0	0	0	77.26	198.4	320.04

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1435.96 (98)

Space heating requirement in kWh/m²/year 18.88 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.93	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	557.08	457.41	462.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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	112.84	166.15	135.99	0	0	0	0

Total = Sum(104)$_{6...8}$ = 414.98 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	16.5	24.3	19.89	0	0	0	0

Total = Sum(107)$_{6...8}$ = 60.7 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.8 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	309.84	238.26	185.24	84.1	22.82	0	0	0	0	77.26	198.4	320.04	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	346.19	266.21	206.97	93.97	25.5	0	0	0	0	86.33	221.68	357.59	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1604.43 (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)

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Water heating

Output from water heater (calculated above)

199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18

Total = $Sum(219a)_{1...12}$ = 2205.19 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	3.49	5.14	4.21	0	0	0	0

Total = $Sum(221)_{6...8}$ = 12.85 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1604.43	
Water heating fuel used		2205.19	
Space cooling fuel used		12.85	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	162.85		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting		332.22	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	55.83	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	76.74	(247)
Space cooling	(221)	13.19	x 0.01 =	1.69	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	25.44	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.82	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 323.53 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.12	(257)

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SAP rating (Section 12)			84.34	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	346.56	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			822.88	(265)
Space cooling	(221) x	0.519	=	6.67	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	100.09	(267)
Electricity for lighting	(232) x	0.519	=	172.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1102.06	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.49	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1957.4	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2690.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4647.74	(265)
Space cooling	(221) x	3.07	=	39.44	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	592.06	(267)
Electricity for lighting	(232) x	0	=	1019.91	(268)
'Total Primary Energy		sum of (265)…(271) =		6299.14	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		82.82	(273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

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

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = Sum(39)1…12 /12= 80.03 (39)

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

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09	

Average = Sum(40)1…12 /12= 1.08 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = Sum(44)1…12 = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = Sum(45)1…12 = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)1…12 — 1951.28 (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

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

(73)m=	537.94	533.3	512.68	480.96	448.52	419.26	402.39	410.78	429.16	461.08	496.57	523.55	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	583.27	616.8	643.65	671.25	687.23	667.49	637.02	607.57	580.4	557.88	552.01	561.6	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.87	0.71	0.53	0.58	0.82	0.96	0.99	0.99	(86)

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

(87)m=	20	20.11	20.3	20.58	20.82	20.96	20.99	20.99	20.91	20.62	20.27	19.98	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.62	0.42	0.47	0.74	0.94	0.98	0.99	(89)

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

(90)m=	18.69	18.84	19.13	19.52	19.84	20	20.03	20.03	19.95	19.59	19.08	18.66	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.03	19.17	19.43	19.8	20.09	20.25	20.28	20.28	20.2	19.86	19.39	19.01	(92)

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

(93)m=	18.88	19.02	19.28	19.65	19.94	20.1	20.13	20.13	20.05	19.71	19.24	18.86	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.93	0.82	0.63	0.43	0.48	0.74	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	575.87	605.41	622.36	620.94	565.31	417.69	276.51	290.25	431.68	518.57	539.72	555.63	(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=	1188.31	1148.17	1036.77	860.66	658.52	433.92	278.39	293.34	471.79	727.51	975.08	1182.62	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	455.65	364.74	308.32	172.6	69.35	0	0	0	0	155.45	313.46	466.49		
Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =													2306.05	(98)

Space heating requirement in kWh/m²/year — 31.14 (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.9	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.97	523.03	519.34	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	70.15	112.05	88.13	0	0	0	0

Total = $Sum(104)_{6...8}$ = 270.33 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (105)

Intermittency factor (Table 10b)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.54	16.83	13.24	0	0	0	0

Total = $Sum(107)_{6...8}$ = 40.61 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.55 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	455.65	364.74	308.32	172.6	69.35	0	0	0	0	155.45	313.46	466.49		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	509.11	407.53	344.49	192.85	77.48	0	0	0	0	173.69	350.23	521.21		
Total (kWh/year) =$Sum(211)_{1...5,10...12}$=													2576.59	(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)

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Water heating

Output from water heater (calculated above)

	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18		
Efficiency of water heater													89.5	(216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72		
								Total = Sum(219a)$_{1...12}$ =					2180.21	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.23	3.56	2.8	0	0	0	0		
								Total = Sum(221)$_{6...8}$ =					8.59	(221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2576.59	
Water heating fuel used		2180.21	
Space cooling fuel used		8.59	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	158.57		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		188.57	(231)
Electricity for lighting		325.25	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	89.67	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.87	(247)
Space cooling	(221)	13.19	x 0.01 =	1.13	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	24.87	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	42.9	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 354.44 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.25	(257)

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SAP rating (Section 12)				82.56	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	556.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1027.47	(265)
Space cooling	(221) x	0.519	=	4.46	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.87	(267)
Electricity for lighting	(232) x	0.519	=	168.8	(268)
Total CO2, kg/year		sum of (265)…(271) =		1298.6	(272)
CO2 emissions per m²		(272) ÷ (4) =		17.53	(273)
EI rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3143.44	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2659.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5803.29	(265)
Space cooling	(221) x	3.07	=	26.38	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	578.91	(267)
Electricity for lighting	(232) x	0	=	998.51	(268)
'Total Primary Energy		sum of (265)…(271) =		7407.1	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		100.01	(273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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) =	76.5	(23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) =	40.9	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	26201.45	(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 — 23.27 (36)

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

Total fabric heat loss — (33) + (36) = 64.17 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75

Average = Sum(39)$_{1...12}$ /12= 80.13 (39)

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

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06

Average = Sum(40)$_{1...12}$ /12= 1.05 (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 — 2.38 (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 — 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1...12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Output from water heater (annual)$_{1...12}$ | 1973.65 | (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)

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

(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)

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

(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)

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

(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

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

(73)m=	547.65	542.94	521.92	489.59	456.5	426.67	409.48	417.99	436.74	469.28	505.45	532.97	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	592.98	626.44	652.89	679.88	695.21	674.9	644.12	614.78	587.98	566.07	560.89	571.02	(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	0.98	0.95	0.87	0.7	0.53	0.58	0.81	0.96	0.99	0.99	(86)

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

(87)m=	20.03	20.14	20.33	20.59	20.83	20.96	20.99	20.99	20.91	20.63	20.29	20.01	(87)

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

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

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

(89)m=	0.99	0.99	0.97	0.93	0.83	0.62	0.42	0.46	0.74	0.94	0.98	0.99	(89)

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

(90)m=	18.75	18.9	19.18	19.56	19.87	20.02	20.05	20.05	19.98	19.63	19.14	18.72	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.08	19.22	19.47	19.83	20.11	20.26	20.29	20.29	20.22	19.88	19.43	19.05	(92)

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

(93)m=	18.93	19.07	19.32	19.68	19.96	20.11	20.14	20.14	20.07	19.73	19.28	18.9	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.97	0.93	0.82	0.62	0.43	0.47	0.74	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	585.64	615.09	631.58	629.12	571.3	420.71	278.09	292.02	435.93	526.17	548.59	565.11	(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=	1192.34	1152.11	1040.35	864.04	661.02	435.82	279.77	294.81	473.87	730.68	979.15	1187.25	(97)

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

(98)m=	451.39	360.87	304.12	169.14	66.76	0	0	0	0	152.15	310.01	462.87

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2277.32 (98)

Space heating requirement in kWh/m²/year 29.94 (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	743.01	584.92	599.29	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.83	0.9	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	614.95	527.28	524.16	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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	71.18	114.17	89.91	0	0	0	0

Total = Sum(104)$_{6...8}$ = 275.25 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.59 (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	10.41	16.7	13.15	0	0	0	0

Total = Sum(107)$_{6...8}$ = 40.26 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.53 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	451.39	360.87	304.12	169.14	66.76	0	0	0	0	152.15	310.01	462.87	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	504.34	403.21	339.8	188.99	74.59	0	0	0	0	170	346.38	517.18	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2544.49 (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)

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Water heating

Output from water heater (calculated above)

	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18

Total = $Sum(219a)_{1...12}$ = 2205.19 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.2	3.53	2.78	0	0	0	0

Total = $Sum(221)_{6...8}$ = 8.52 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2544.49	
Water heating fuel used		2205.19	
Space cooling fuel used		8.52	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	162.85		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting		332.22	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	88.55	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	76.74	(247)
Space cooling	(221)	13.19	x 0.01 =	1.12	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	25.44	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	43.82	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 355.67 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.23	(257)

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SAP rating (Section 12)				82.79	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	549.61	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1025.93	(265)
Space cooling	(221) x	0.519	=	4.42	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	100.09	(267)
Electricity for lighting	(232) x	0.519	=	172.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1302.87	(272)
CO2 emissions per m²		(272) ÷ (4) =		17.13	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3104.28	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2690.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5794.62	(265)
Space cooling	(221) x	3.07	=	26.16	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	592.06	(267)
Electricity for lighting	(232) x	0	=	1019.91	(268)
‘Total Primary Energy		sum of (265)…(271) =		7432.75	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		97.72	(273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	54.34	(1a) x	2.6	(2a) =	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	141.28	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

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

Total fabric heat loss (33) + (36) = 69.69 (37)

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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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

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

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = Sum(39)$_{1…12}$ /12= 81.67 (39)

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

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51

Average = Sum(40)$_{1…12}$ /12= 1.5 (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 1.82 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12

Total = Sum(44)$_{1…12}$ = 928.53 (44)

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

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24

Total = Sum(45)$_{1…12}$ = 1217.45 (45)

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

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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)

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

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

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=	43.37	37.75	40.22	37.4	37.06	34.34	35.49	37.06	37.4	40.22	40.45	43.37	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61

Output from water heater (annual)$_{1...12}$ — 1681.59 (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=	52.81	46.14	47.93	42.37	40.95	35.93	34.21	38.34	38.77	44.34	47.54	51.49	(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=	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	35.32	31.37	25.51	19.32	14.44	12.19	13.17	17.12	22.98	29.18	34.05	36.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	236.54	239	232.81	219.64	203.02	187.4	176.96	174.51	180.69	193.86	210.48	226.11	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	(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=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)
Water heating gains (Table 5)													
(72)m=	70.98	68.67	64.43	58.85	55.04	49.9	45.98	51.53	53.85	59.6	66.03	69.2	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	429.93	426.12	409.84	384.89	359.59	336.57	323.2	330.25	344.61	369.73	397.65	418.7	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

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

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

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

(84)m=	461.31	485.81	508.08	534.4	552.4	539.15	513.86	486.89	460.33	440.16	436.37	444.82	(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

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(86)m=	0.99	0.99	0.98	0.96	0.91	0.79	0.64	0.68	0.87	0.97	0.99	0.99	(86)

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

(87)m=	19.5	19.62	19.87	20.23	20.58	20.85	20.95	20.94	20.74	20.31	19.85	19.48	(87)

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

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

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

(89)m=	0.99	0.99	0.97	0.94	0.86	0.68	0.47	0.53	0.8	0.95	0.98	0.99	(89)

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

(90)m=	17.74	17.91	18.27	18.79	19.27	19.59	19.68	19.67	19.49	18.92	18.25	17.71	(90)

fLA = Living area ÷ (4) = 0.25 (91)

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

(92)m=	18.18	18.34	18.67	19.15	19.6	19.91	20	19.99	19.8	19.27	18.65	18.15	(92)

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

(93)m=	18.03	18.19	18.52	19	19.45	19.76	19.85	19.84	19.65	19.12	18.5	18	(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	0.98	0.97	0.93	0.85	0.69	0.49	0.54	0.8	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	454.05	475.64	490.97	498.43	471.4	371.99	254.18	265	365.97	412.41	425.65	438.72	(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=	1136.02	1097.85	991.21	825.15	632	416.84	262.56	277.47	450.28	694.48	933.39	1133.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	507.38	418.12	372.18	235.24	119.48	0	0	0	0	209.86	365.57	516.97	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2744.81 (98)

Space heating requirement in kWh/m²/year 50.51 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.68	0.76	0.72	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.49	456.79	444.35	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	570.35	543.05	510.34	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	0	64.18	49.1	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 113.27 (104)

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(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) =	0	(106)

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

(107)m=	0	0	0	0	0	0	11.22	8.58	0	0	0	0

	Total = Sum(107) =	19.8	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.36	(108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	507.38	418.12	372.18	235.24	119.48	0	0	0	0	209.86	365.57	516.97	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	566.91	467.18	415.84	262.84	133.5	0	0	0	0	234.48	408.46	577.62	(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3066.82 (211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)													
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0 (215)
Water heating													
Output from water heater (calculated above)	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61	
Efficiency of water heater													89.5 (216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	189.49	165.53	172.22	152.75	147.89	130.25	124.79	139.11	140.65	160.16	170.97	185.04	
Total = Sum(219a)$_{1...12}$ =													1878.87 (219)
Space cooling fuel, kWh/month. (221)m = (107)m÷ (209)													
(221)m=	0	0	0	0	0	0	2.37	1.82	0	0	0	0	
Total = Sum(221)$_{6...8}$ =													4.19 (221)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3066.82
Water heating fuel used		1878.87
Space cooling fuel used		4.19

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Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		90.49		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		120.49	(231)
Electricity for lighting			249.52	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	106.73	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	65.38	(247)
Space cooling	(221)	13.19	x 0.01 =	0.55	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	15.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	32.91	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			341.47	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.44	(257)
SAP rating (Section 12)		79.86	(258)

12a. CO_2 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	=	662.43	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	405.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1068.27	(265)
Space cooling	(221) x	0.519	=	2.18	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.54	(267)
Electricity for lighting	(232) x	0.519	=	129.5	(268)
Total CO2, kg/year		sum of (265)…(271) =		1262.48	(272)
CO2 emissions per m²		(272) ÷ (4) =		23.23	(273)
EI rating (section 14)				83	(274)

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13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	3741.52	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2292.22	(264)
Space and water heating	(261) + (262) + (263) + (264) =				6033.74	(265)
Space cooling	(221)	x	3.07	=	12.87	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	369.91	(267)
Electricity for lighting	(232)	x	0	=	766.03	(268)
'Total Primary Energy			sum of (265)…(271) =		7182.55	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		132.18	(273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.59	(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (36)

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

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Total fabric heat loss (33) + (36) = 69.75 (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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

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

(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87	

Average = $Sum(39)_{1...12}$ /12= 81.42 (39)

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

(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09	

Total = $Sum(44)_{1...12}$ = 939.13 (44)

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

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64	

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

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

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	43.87	38.18	40.68	37.82	37.49	34.74	35.89	37.49	37.82	40.68	40.91	43.87	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51

Output from water heater (annual)$_{1...12}$ | 1700.79 | (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=	53.42	46.67	48.48	42.86	41.42	36.34	34.6	38.78	39.21	44.85	48.08	52.08	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	(66)

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

(67)m=	36.05	32.02	26.04	19.71	14.74	12.44	13.44	17.47	23.45	29.78	34.76	37.05	(67)

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

(68)m=	241.43	243.93	237.62	224.18	207.21	191.27	180.62	178.11	184.42	197.86	214.83	230.77	(68)

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

(69)m=	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	71.8	69.45	65.16	59.52	55.67	50.47	46.51	52.12	54.46	60.28	66.78	70	(72)

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

(73)m=	437.37	433.5	416.91	391.51	365.71	342.27	328.66	335.8	350.43	376.02	404.46	425.91	(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	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

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

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

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

(84)m=	468.74	493.18	515.15	541.01	558.53	544.84	519.32	492.44	466.16	446.45	443.18	452.03	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.96	0.91	0.78	0.63	0.68	0.87	0.97	0.99	0.99	(86)

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

(87)m=	19.55	19.67	19.91	20.26	20.6	20.86	20.96	20.94	20.76	20.34	19.89	19.52	(87)

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

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

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

(89)m=	0.99	0.99	0.98	0.94	0.86	0.68	0.47	0.52	0.8	0.95	0.98	0.99	(89)

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

(90)m=	17.82	17.99	18.35	18.85	19.32	19.63	19.71	19.7	19.53	18.97	18.32	17.79	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	18.26	18.42	18.75	19.21	19.65	19.94	20.03	20.02	19.84	19.32	18.72	18.23	(92)

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

(93)m=	18.11	18.27	18.6	19.06	19.5	19.79	19.88	19.87	19.69	19.17	18.57	18.08	(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	0.98	0.97	0.93	0.85	0.69	0.49	0.54	0.79	0.94	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	461.57	483.12	498.16	505.04	476.92	375.62	256.54	267.58	370.47	418.58	432.52	446.02	(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=	1138.64	1100.41	993.62	827.54	634.03	418.75	264.44	279.39	452.37	697.01	936.25	1136.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	503.74	414.82	368.62	232.2	116.89	0	0	0	0	207.15	362.68	513.77	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2719.88 | (98)

Space heating requirement in kWh/m²/year | 48.91 | (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.68	0.77	0.73	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	518.44	460.63	448.62	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	576.05	548.51	515.89	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	0	65.38	50.05	0	0	0	0

Total = Sum$(104)_{6..8}$ = 115.43 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.68 (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	0	11.17	8.55	0	0	0	0

Total = Sum$(107)_{6..8}$ = 19.72 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.35 (108)

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 89.5 (206)

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

Cooling System Energy Efficiency Ratio 4.73 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	503.74	414.82	368.62	232.2	116.89	0	0	0	0	207.15	362.68	513.77	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	562.83	463.49	411.87	259.44	130.6	0	0	0	0	231.45	405.23	574.05	(211)

Total (kWh/year) =Sum$(211)_{1...5,10....12}$= 3038.97 (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)

171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	191.66	167.42	174.19	154.5	149.58	131.74	126.22	140.7	142.26	161.99	172.92	187.16

Total = Sum$(219a)_{1...12}$ = 1900.33 (219)

Space cooling fuel, kWh/month.
(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	0	2.36	1.81	0	0	0	0

Total = Sum$(221)_{6...8}$ = 4.17 (221)

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Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3038.97	
Water heating fuel used			1900.33	
Space cooling fuel used			4.17	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		92.61		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		122.61	(231)
Electricity for lighting			254.67	(232)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	105.76	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	66.13	(247)
Space cooling	(221)	13.19	x 0.01 =	0.55	(248)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	16.17	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	33.59	(250)
Additional standing charges (Table 12)				120	(251)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	342.2	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.43	(257)
SAP rating (Section 12)		80.07	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	656.42	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	410.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1066.89	(265)
Space cooling	(221) x	0.519	=	2.17	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	63.63	(267)

Electricity for lighting	(232) x	0.519	=	132.18	(268)
Total CO2, kg/year		sum of (265)…(271) =		1264.86	(272)
CO2 emissions per m²		(272) ÷ (4) =		22.75	(273)
EI rating (section 14)				83	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3707.54	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2318.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6025.94	(265)
Space cooling	(221) x	3.07	=	12.81	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	376.4	(267)
Electricity for lighting	(232) x	0	=	781.85	(268)
'Total Primary Energy		sum of (265)…(271) =		7197	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		129.42	(273)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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

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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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		36.66	(36)

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

Total fabric heat loss	(33) + (36) =	107.78	(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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

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

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = Sum(39)1…12 /12= 133.24 (39)

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

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = Sum(40)1…12 /12= 1.24 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68

Total = Sum(44)1…12 = 1207.41 (44)

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

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96

Total = Sum(45)1…12 = 1583.1 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year (48) x (49) = 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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23	(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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23

Output from water heater (annual)$_{1...12}$ 2233.94 (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=	98.8	87.67	93.48	85.74	85.42	78.35	77.17	82.03	81.05	88.81	91.47	97.07	(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=	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	(66)

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

(67)m=	59.59	52.93	43.05	32.59	24.36	20.57	22.22	28.89	38.77	49.23	57.46	61.25	(67)

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

(68)m=	399.08	403.22	392.78	370.57	342.52	316.16	298.56	294.41	304.85	327.07	355.11	381.47	(68)

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

(69)m=	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	(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=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

Water heating gains (Table 5)

(72)m=	132.79	130.47	125.64	119.08	114.82	108.82	103.72	110.25	112.57	119.37	127.03	130.48	(72)

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

(73)m=	701.97	697.12	671.97	632.74	592.21	556.06	535.01	544.06	566.7	606.17	650.11	683.7	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast	0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast	0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast	0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast	0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast	0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast	0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast	0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast	0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast	0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast	0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast	0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast	0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast	0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast	0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast	0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast	0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast	0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast	0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast	0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast	0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast	0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast	0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast	0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast	0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast	0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast	0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast	0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast	0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast	0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast	0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast	0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast	0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast	0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast	0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast	0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast	0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast	0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast	0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast	0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast	0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast	0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast	0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast	0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

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

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

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

(84)m=	770.81	821.52	861.16	898.96	919.42	893.67	855.19	816.79	782.26	748.77	733.86	741.77	(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	0.97	0.92	0.8	0.64	0.68	0.88	0.97	0.99	1	(86)

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

(87)m=	19.72	19.83	20.05	20.36	20.67	20.89	20.97	20.96	20.81	20.44	20.03	19.7	(87)

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

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

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

(89)m=	0.99	0.99	0.98	0.96	0.89	0.71	0.5	0.55	0.82	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=	18.18	18.35	18.67	19.12	19.54	19.82	19.89	19.88	19.73	19.24	18.64	18.16	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.4	18.57	18.87	19.31	19.71	19.98	20.05	20.04	19.89	19.41	18.85	18.38	(92)

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

(93)m=	18.4	18.57	18.87	19.31	19.71	19.98	20.05	20.04	19.89	19.41	18.85	18.38	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.88	0.72	0.52	0.57	0.82	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	764.09	811.05	841.82	854.42	809.22	641.82	442.49	461.6	639.01	713.58	722.85	736.33	(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=	1911.48	1847.76	1668.75	1387.27	1064.92	706.81	453.01	477.53	764.89	1171.98	1569.68	1904	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	853.66	696.67	615.23	383.65	190.24	0	0	0	0	341.05	609.72	868.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4558.96 (98)

Space heating requirement in kWh/m²/year 42.55 (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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		4558.96	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	622.3	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4164.61	(307b)
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		2233.94	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	304.93	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2040.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	71.33	(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		247.21	(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) =	247.21	(331)
Energy for lighting (calculated in Appendix L)		420.97	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	18.48	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	176.58	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	9.06	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	86.53	(342b)
			Fuel Price			
Pumps and fans	(331)		13.19	x 0.01 =	32.61	(349)
Energy for lighting	(332)		13.19	x 0.01 =	55.53	(350)
Additional standing charges (Table 12)					120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =				498.78	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.38	(357)
SAP rating (section12)		80.79	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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

Space heating from CHP)	(307a) × 100 ÷ (362) =		987.78	x	0.22		213.36	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =		302.26	x	0.52		-156.87	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =		484.02	x	0.22		104.55	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =		148.11	x	0.52		-76.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel						96.7	(367b)
CO2 associated with heat source 2		[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1386.09	(368)
Electrical energy for heat distribution		[(313) x			0.52	=	37.02	(372)
Total CO2 associated with community systems		(363)…(366) + (368)...(372)				=	1507.27	(373)
CO2 associated with space heating (secondary)		(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater		(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating		(373) + (374) + (375) =					1507.27	(376)
CO2 associated with electricity for pumps and fans within dwelling		(331)) x			0.52	=	128.3	(378)
CO2 associated with electricity for lighting		(332))) x			0.52	=	218.48	(379)
Total CO2, kg/year	sum of (376)…(382) =						1854.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =						17.31	(384)
EI rating (section 14)							83.67	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit							30.6	(361)
Heat efficiency of CHP unit							63	(362)
			Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =		987.78	x	1.22		1205.09	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =		302.26	x	3.07		-927.94	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =		484.02	x	1.22		590.51	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =		148.11	x	3.07		-454.7	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel						96.7	(367b)
Energy associated with heat source 2		[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	7828.84	(368)
Electrical energy for heat distribution		[(313) x				=	218.97	(372)
Total Energy associated with community systems		(363)…(366) + (368)...(372)				=	8460.77	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)							8460.77	(373)
Energy associated with space heating (secondary)		(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater		(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating		(373) + (374) + (375) =					8460.77	(376)
Energy associated with space cooling		(315) x			3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling		(331)) x			3.07	=	758.92	(378)
Energy associated with electricity for lighting		(332))) x			3.07	=	1292.39	(379)

Total Primary Energy, kWh/year	sum of (376)…(382) =	10512.08	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	308.41	(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

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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.15	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) =	76.5	(23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

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

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86	(38)

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

(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37	

Average = Sum(39)$_{1…12}$ /12= 133.41 (39)

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

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	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 2.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 101.09 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2	

Total = Sum(44)$_{1…12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7	

Total = Sum(45)$_{1…12}$ = 1590.57 (45)

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

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)
Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98	(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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98

Output from water heater (annual)$_{1...12}$ — 2241.41 (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=	99.05	87.9	93.71	85.94	85.62	78.52	77.32	82.21	81.23	89.02	91.69	97.32	(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=	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	(66)

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

(67)m=	60.61	53.84	43.78	33.15	24.78	20.92	22.6	29.38	39.43	50.07	58.44	62.3	(67)

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

(68)m=	405.91	410.12	399.5	376.91	348.38	321.58	303.67	299.45	310.07	332.66	361.19	388	(68)

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

(69)m=	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	(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=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

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Water heating gains (Table 5)

(72)m=	133.14	130.8	125.95	119.36	115.08	109.05	103.93	110.49	112.83	119.65	127.35	130.81	(72)

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

(73)m=	710.7	705.8	680.28	640.46	599.29	562.59	541.24	550.37	573.37	613.43	658.03	692.15	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest	0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest	0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest	0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest	0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest	0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest	0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest	0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest	0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest	0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

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

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

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

(84)m=	769.12	813.98	851.34	891.03	915.2	891.72	852.11	810.12	771.59	739.2	729.57	741.12	(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	0.97	0.93	0.81	0.64	0.69	0.89	0.98	0.99	1	(86)

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

(87)m=	19.74	19.85	20.06	20.37	20.67	20.89	20.97	20.96	20.81	20.44	20.04	19.72	(87)

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

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

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

(89)m=	0.99	0.99	0.99	0.96	0.89	0.72	0.5	0.56	0.83	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=	18.24	18.4	18.71	19.16	19.57	19.85	19.91	19.91	19.76	19.26	18.69	18.21	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.45	18.6	18.9	19.33	19.73	20	20.06	20.06	19.91	19.43	18.88	18.43	(92)

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

(93)m=	18.45	18.6	18.9	19.33	19.73	20	20.06	20.06	19.91	19.43	18.88	18.43	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.72	0.52	0.57	0.83	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	763.17	804.92	834.49	850.77	810.96	645.93	445.84	464.75	638.51	708.01	719.86	736.3	(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=	1918.15	1853.33	1673.4	1391.97	1069.2	710.74	456.18	480.77	768.26	1176	1575.8	1911.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	859.31	704.53	624.14	389.67	192.13	0	0	0	0	348.18	616.28	874.55	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 4608.78 (98)

Space heating requirement in kWh/m²/year 41.79 (99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		4608.78	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	629.1	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4210.12	(307b)
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		2241.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	305.95	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2047.53	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	71.93	(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		253.98	(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) =	253.98	(331)
Energy for lighting (calculated in Appendix L)		428.18	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	18.68	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	178.51	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	9.09	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	86.82	(342b)
		Fuel Price			
Pumps and fans	(331)	13.19	x 0.01 =	33.5	(349)
Energy for lighting	(332)	13.19	x 0.01 =	56.48	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			503.07	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.36	(357)
SAP rating (section12)		81.02	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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

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Space heating from CHP)	(307a) × 100 ÷ (362) =	998.57	x	0.22		215.69	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	305.56	x	0.52		-158.59	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	0.22		104.9	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	0.52		-77.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1397.78	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	37.33	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1519.98	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1519.98	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	131.81	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	222.22	(379)
Total CO2, kg/year	sum of (376)…(382) =					1874.02	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					16.99	(384)
EI rating (section 14)						83.83	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	998.57	x	1.22		1218.25	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	305.56	x	3.07		-938.08	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	1.22		592.48	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	3.07		-456.22	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	7894.86	(368)
Electrical energy for heat distribution	[(313) x				=	220.82	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	8532.11	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						8532.11	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					8532.11	(376)
Energy associated with space cooling	(315) x			3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	779.71	(378)
Energy associated with electricity for lighting	(332))) x			3.07	=	1314.51	(379)

Total Primary Energy, kWh/year	sum of (376)…(382) =	10626.33	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	74.06	(1a)	x	2.6	(2a)	=	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			192.56	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27754.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.19 (36)

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

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = Sum(39)$_{1...12}$ /12= 74.07 (39)

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

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = Sum(44)$_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = Sum(45)$_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

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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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ 2063.55 (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

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

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(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	0.97	0.93	0.82	0.64	0.47	0.51	0.75	0.93	0.98	0.99	(86)

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

(87)m=	20.16	20.26	20.45	20.69	20.89	20.98	21	21	20.95	20.73	20.41	20.14	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

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

(89)m=	0.99	0.98	0.96	0.91	0.77	0.55	0.37	0.41	0.67	0.91	0.97	0.99	(89)

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

(90)m=	18.97	19.12	19.38	19.73	19.98	20.08	20.1	20.1	20.05	19.78	19.34	18.95	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.28	19.42	19.66	19.98	20.22	20.32	20.33	20.33	20.29	20.03	19.62	19.26	(92)

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

(93)m=	19.28	19.42	19.66	19.98	20.22	20.32	20.33	20.33	20.29	20.03	19.62	19.26	(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	0.98	0.96	0.9	0.78	0.58	0.4	0.44	0.69	0.91	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	612.34	640.89	654.54	643.07	569.19	408.39	271.17	284.41	430.33	542.31	574.22	592.57	(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=	1131.72	1093.79	988.85	821.51	629.44	416.89	272.05	285.88	453.67	697.08	930.55	1125.41	(97)

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

(98)m=	386.42	304.34	248.73	128.48	44.83	0	0	0	0	115.15	256.56	396.43

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1880.94 (98)

Space heating requirement in kWh/m²/year 25.4 (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	685.27	539.47	552.51	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.06	508.87	511.09	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	103.63	156.51	127.74	0	0	0	0

Total = Sum(104)$_{6...8}$ = 387.89 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (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	15.57	23.51	19.19	0	0	0	0

Total = Sum(107)$_{6...8}$ = 58.27 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.79 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		1880.94	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	256.75	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1718.24	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	41.42	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.33	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	7.63	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	72.85	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	79.93	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	1.63	(348)
Pumps and fans	(331)	13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)	13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			354.21	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.25	(357)
SAP rating (section12)		82.57	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	407.54	x	0.22		88.03	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	124.71	x	0.52		-64.72	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	804.87	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21.5	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	875.24	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					875.24	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.4	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1132.74	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					15.29	(384)
EI rating (section 14)						87.25	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	407.54	x	1.22		497.2	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	124.71	x	3.07		-382.85	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22		545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07		-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4546.04	(368)
Electrical energy for heat distribution	[(313) x				=	127.15	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	4912.98	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						4912.98	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					4912.98	(376)

SAP WorkSheet: New dwelling design stage

Energy associated with space cooling	(315) x	3.07	= 37.86	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	= 486.81	(378)
Energy associated with electricity for lighting	(332))) x	3.07	= 998.51	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =		6436.16	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) = 39.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27990.6 (34)

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

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.24 | (36)

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

Total fabric heat loss (33) + (36) = | 57.66 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24

Average = $Sum(39)_{1...12}$ /12= | 73.62 | (39)

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

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98

Average = $Sum(40)_{1...12}$ /12= | 0.97 | (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = | 1428.9 | (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(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	0.97	0.93	0.82	0.63	0.46	0.5	0.74	0.93	0.98	0.99	(86)

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

(87)m=	20.2	20.3	20.48	20.71	20.9	20.98	21	21	20.96	20.75	20.44	20.18	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

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

(89)m=	0.99	0.98	0.96	0.9	0.77	0.55	0.37	0.41	0.67	0.91	0.97	0.99	(89)

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

(90)m=	19.05	19.19	19.45	19.78	20.02	20.11	20.12	20.12	20.08	19.83	19.41	19.03	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.34	19.48	19.71	20.02	20.24	20.33	20.35	20.35	20.31	20.07	19.67	19.32	(92)

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

(93)m=	19.34	19.48	19.71	20.02	20.24	20.33	20.35	20.35	20.31	20.07	19.67	19.32	(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	0.98	0.96	0.9	0.78	0.57	0.39	0.43	0.69	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	621.82	650.21	663.11	649.75	572.29	408.52	270.92	284.23	431.77	548.6	582.65	601.8	(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=	1128.3	1090.51	985.89	819.34	627.57	415.88	271.64	285.45	452.57	695.54	928.43	1122.57	(97)

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

(98)m=	376.82	295.88	240.15	122.1	41.13	0	0	0	0	109.32	248.96	387.45	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 1821.82 (98)

Space heating requirement in kWh/m²/year 23.95 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	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	610.8	509.45	512.46	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	106.88	161.24	131.96	0	0	0	0	

Total = Sum(104)6...8 = 400.08 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	15.63	23.58	19.3	0	0	0	0

Total = Sum(107)6...8 = 58.52 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.77 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 1821.82

Space heat from Community CHP (98) x (304a) x (305) x (306) = 248.68 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1664.23	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	40.97	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.38	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	7.39	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	70.56	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	80.55	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	1.63	(348)
Pumps and fans	(331)		13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)		13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)					120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =				353.87	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.23	(357)
SAP rating (section12)		82.87	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	394.73	x	0.22		85.26	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	120.79	x	0.52		-62.69	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	796.11	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21.26	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	865.71	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					865.71	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.43	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1129.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					14.84	(384)
EI rating (section 14)						87.5	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Primary factor		P.Energy kWh/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	394.73	x	1.22		481.57	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	120.79	x	3.07		-370.81	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22		549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07		-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4496.56	(368)
Electrical energy for heat distribution	[(313) x				=	125.77	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	4859.51	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						4859.51	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					4859.51	(376)

Energy associated with space cooling	(315) x	3.07	=	38.02	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1019.91	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			6417.4	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) = 37.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27828.4 (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 11.04 (36)

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

SAP WorkSheet: New dwelling design stage

Total fabric heat loss	(33) + (36) =	48.97	(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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = $Sum(39)_{1...12}$ /12= 65.3 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = $Sum(40)_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ 2063.55 (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

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

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(73)

6. Solar gains:

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

SAP 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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest 0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest 0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest 0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest 0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest 0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest 0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest 0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest 0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest 0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(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	0.9	0.77	0.57	0.41	0.45	0.69	0.91	0.98	0.99	(86)

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

(87)m=	20.34	20.43	20.6	20.8	20.94	20.99	21	21	20.98	20.82	20.56	20.32	(87)

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

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

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

(89)m=	0.98	0.97	0.95	0.88	0.72	0.5	0.34	0.37	0.62	0.88	0.97	0.99	(89)

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

(90)m=	19.3	19.44	19.67	19.96	20.13	20.19	20.2	20.2	20.18	19.99	19.62	19.28	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.57	19.7	19.91	20.18	20.34	20.4	20.41	20.41	20.39	20.21	19.87	19.55	(92)

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

(93)m=	19.57	19.7	19.91	20.18	20.34	20.4	20.41	20.41	20.39	20.21	19.87	19.55	(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	0.97	0.95	0.88	0.73	0.52	0.36	0.39	0.64	0.88	0.96	0.98	(94)

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

(95)m=	610.65	637.77	647.51	624.44	533.14	369.15	243.92	255.84	395.74	527.34	570.3	591.24	(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=	1019.54	985.02	890.14	737.34	563.16	372.11	244.15	256.26	405.7	626.16	837.01	1012.47	(97)

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

(98)m=	304.21	233.35	180.52	81.29	22.33	0	0	0	0	73.52	192.03	313.39		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				1400.63	(98)

Space heating requirement in kWh/m²/year — 18.91 (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	602.87	474.6	485.89	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	566.25	462.49	468.37	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	133.74	191.02	159.52	0	0	0	0		
									Total = Sum(104)$_{6...8}$ =				484.28	(104)
Cooled fraction									f C = cooled area ÷ (4) =				0.6	(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	20.09	28.69	23.96	0	0	0	0		
									Total = Sum(107)$_{6...8}$ =				72.75	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =				0.98	(108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		1400.63	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	191.19	(307a)

Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1279.47	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.37	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.4	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	5.68	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	54.25	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	79.93	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	2.03	(348)
Pumps and fans	(331)	13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)	13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			334.07	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.18	(357)
SAP rating (section12)		83.56	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	303.47	x	0.22		65.55	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	92.86	x	0.52		-48.2	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	706.86	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	18.88	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	768.66	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					768.66	(376)
CO2 associated with space cooling	(315) x			0.52	=	7.99	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1027.76	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					13.88	(384)
EI rating (section 14)						88.43	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)

		Energy kWh/year		Primary factor		P.Energy kWh/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	303.47	x	1.22		370.23	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	92.86	x	3.07		-285.09	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22		545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07		-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	3992.47	(368)
Electrical energy for heat distribution	[(313) x				=	111.67	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	4314.74	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						4314.74	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					4314.74	(376)

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Energy associated with space cooling	(315) x	3.07	=	47.27	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	486.81	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	998.51	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			5847.32	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) = 37.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28062.4 (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 (36)

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

Total fabric heat loss (33) + (36) = 48.84 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = Sum(39)$_{1…12}$ /12= 64.8 (39)

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

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = Sum(40)$_{1…12}$ /12= 0.85 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9	

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47	

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)

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

(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)

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

(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)

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

(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

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

(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(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	0.9	0.76	0.56	0.41	0.44	0.68	0.91	0.97	0.99	(86)

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

(87)m=	20.37	20.47	20.62	20.82	20.95	20.99	21	21	20.98	20.84	20.58	20.35	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.98	0.97	0.95	0.87	0.71	0.5	0.34	0.37	0.61	0.88	0.97	0.99	(89)

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

(90)m=	19.37	19.51	19.73	20.01	20.16	20.22	20.22	20.22	20.2	20.04	19.69	19.35	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	19.63	19.75	19.96	20.22	20.37	20.42	20.42	20.42	20.4	20.24	19.92	19.61	(92)

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

(93)m=	19.63	19.75	19.96	20.22	20.37	20.42	20.42	20.42	20.4	20.24	19.92	19.61	(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	0.97	0.95	0.87	0.72	0.51	0.35	0.39	0.63	0.88	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	619.92	646.73	655.34	629.43	533.92	368.11	243.17	255.1	395.47	532.19	578.3	600.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1014.49	980.17	885.73	733.89	560.3	370.53	243.35	255.42	403.9	623.51	833.54	1008.02	(97)

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

(98)m=	293.56	224.07	171.41	75.21	19.62	0	0	0	0	67.94	183.77	303.34

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1338.92 (98)

Space heating requirement in kWh/m²/year 17.6 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.98	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.6	461.21	467.74	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	138.71	197.13	165.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 501.07 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	20.29	28.83	24.17	0	0	0	0

Total = Sum(107)$_{6...8}$ = 73.29 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.96 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 1338.92

Space heat from Community CHP (98) x (304a) x (305) x (306) = 182.76 (307a)

Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1223.1	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.9	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.51	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	5.43	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	51.86	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	80.55	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	2.05	(348)
Pumps and fans	(331)	13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)	13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			333.62	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.16	(357)
SAP rating (section12)		83.85	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	290.1	x	0.22		62.66	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	88.77	x	0.52		-46.07	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	697.58	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	18.63	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	758.56	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					758.56	(376)
CO2 associated with space cooling	(315) x			0.52	=	8.05	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1023.56	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					13.46	(384)
EI rating (section 14)						88.67	(385)

13b. Primary Energy – Community heating scheme

		Energy kWh/year		Primary factor		P.Energy kWh/year	
Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
Space heating from CHP)	(307a) × 100 ÷ (362) =	290.1	x	1.22		353.92	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	88.77	x	3.07		-272.52	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22		549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07		-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	3940.01	(368)
Electrical energy for heat distribution	[(313) x				=	110.2	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	4258.04	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						4258.04	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					4258.04	(376)

Energy associated with space cooling	(315) x	3.07	=	47.62	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1019.91	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			5825.53	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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

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

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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

* *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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

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

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = $Sum(39)_{1...12}$ /12= 80.03 (39)

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

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09	

Average = $Sum(40)_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

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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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	

Output from water heater (annual)1…12 2063.55 (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

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

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.5	0.55	0.78	0.94	0.98	0.99	(86)

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

(87)m=	20.05	20.15	20.35	20.61	20.84	20.97	20.99	20.99	20.92	20.66	20.31	20.03	(87)

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

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

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

(89)m=	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.44	0.71	0.92	0.98	0.99	(89)

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

(90)m=	18.76	18.91	19.19	19.57	19.87	20.01	20.03	20.03	19.97	19.64	19.15	18.73	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.09	19.24	19.49	19.85	20.12	20.26	20.28	20.28	20.22	19.91	19.46	19.07	(92)

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

(93)m=	19.09	19.24	19.49	19.85	20.12	20.26	20.28	20.28	20.22	19.91	19.46	19.07	(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	0.98	0.96	0.91	0.81	0.61	0.42	0.47	0.72	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	612.97	642.13	657.44	651.26	587.23	431.69	288.54	302.43	449.1	548.84	575.78	593.05	(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=	1205.77	1165.52	1053.8	876.6	672.69	446.3	290.31	305.28	484.96	743.42	992.13	1199.96	(97)

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

(98)m=	441.04	351.72	294.89	162.24	63.58	0	0	0	0	144.77	299.77	451.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2209.56 (98)

Space heating requirement in kWh/m²/year 29.83 (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	628.97	534.61	533.86	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	88.58	137.36	110.8	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 336.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	13.31	20.63	16.64	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.68 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 2209.56

Space heat from Community CHP (98) x (304a) x (305) x (306) = 301.6 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2018.43	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.87	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.71	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	8.96	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	85.58	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	79.93	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	1.41	(348)
Pumps and fans	(331)	13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)	13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			368.06	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.3	(357)
SAP rating (section12)		81.89	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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	Formula	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	478.74	x	0.22		103.41	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	146.49	x	0.52		-76.03	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	871.93	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.29	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	948.16	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					948.16	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.56	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1204.81	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					16.27	(384)
EI rating (section 14)						86.44	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

	Formula	Energy kWh/year		Primary factor		P.Energy kWh/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	478.74	x	1.22		584.06	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	146.49	x	3.07		-449.74	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22		545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07		-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4924.77	(368)
Electrical energy for heat distribution	[(313) x				=	137.74	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5322.28	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5322.28	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5322.28	(376)

Energy associated with space cooling	(315) x		3.07	=	32.87	(377)
Energy associated with electricity for pumps and fans within dwelling		(331)) x	3.07	=	486.81	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	998.51	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =				6840.47	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	76.06	(1a)	x	2.6	(2a)	=	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	197.76	(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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26201.45 (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 | 23.27 | (36)

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

Total fabric heat loss (33) + (36) = | 64.17 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75

Average = Sum(39)$_{1...12}$ /12= | 80.13 | (39)

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

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06

Average = Sum(40)$_{1...12}$ /12= | 1.05 | (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 | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1...12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1...12}$ = | 1428.9 | (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)

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

(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)

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

(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)

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

(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

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

(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

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Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.5	0.54	0.78	0.94	0.98	0.99	(86)

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

(87)m=	20.08	20.18	20.37	20.63	20.85	20.97	20.99	20.99	20.93	20.67	20.34	20.06	(87)

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

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

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

(89)m=	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.44	0.7	0.92	0.98	0.99	(89)

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

(90)m=	18.82	18.97	19.24	19.61	19.9	20.03	20.05	20.05	19.99	19.68	19.2	18.79	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.14	19.28	19.53	19.87	20.14	20.27	20.29	20.29	20.23	19.93	19.49	19.12	(92)

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

(93)m=	19.14	19.28	19.53	19.87	20.14	20.27	20.29	20.29	20.23	19.93	19.49	19.12	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.91	0.8	0.61	0.42	0.46	0.72	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	622.58	651.67	666.51	659.26	592.98	434.6	290.12	304.19	453.11	556.23	584.49	602.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1209.67	1169.35	1057.27	879.88	675.13	448.18	291.7	306.76	486.99	746.49	996.1	1204.48	(97)

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

(98)m=	436.8	347.88	290.73	158.85	61.12	0	0	0	0	141.56	296.36	447.97

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2181.26 (98)

Space heating requirement in kWh/m²/year 28.68 (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	743.01	584.92	599.29	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	634.58	538.46	538.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	89.76	139.66	112.76	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 342.18 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	13.13	20.43	16.49	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.05 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.66 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2181.26	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	297.74	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1992.58	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.74	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.59	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	8.84	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	84.49	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	80.55	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	1.4	(348)
Pumps and fans	(331)	13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)	13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			369.01	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.28	(357)
SAP rating (section12)		82.14	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

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		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	472.61	x	0.22		102.08	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	144.62	x	0.52		-75.06	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	869.46	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.22	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	945.47	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					945.47	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.5	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1207.91	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					15.88	(384)
EI rating (section 14)						86.63	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Primary factor		P.Energy kWh/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	472.61	x	1.22		576.58	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	144.62	x	3.07		-443.98	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22		549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07		-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4910.81	(368)
Electrical energy for heat distribution	[(313) x				=	137.35	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5307.2	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5307.2	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5307.2	(376)

Energy associated with space cooling	(315) x	3.07	=	32.52	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1019.91	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =			6859.59	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	54.34	(1a) x	2.6	(2a) =	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	141.28	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

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

Total fabric heat loss (33) + (36) = 69.69 (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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

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

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = Sum(39)$_{1…12}$ /12= 81.67 (39)

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

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51	

Average = Sum(40)$_{1…12}$ /12= 1.5 (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 1.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12	

Total = Sum(44)$_{1…12}$ = 928.53 (44)

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

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24	

Total = Sum(45)$_{1…12}$ = 1217.45 (45)

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

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52

Output from water heater (annual)$_{1...12}$ — 1868.29 (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=	86.19	76.65	82.1	75.82	75.91	70.14	69.56	73.3	72.22	78.51	80.22	84.87	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	(66)

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

(67)m=	35.32	31.37	25.51	19.32	14.44	12.19	13.17	17.12	22.98	29.18	34.05	36.3	(67)

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

(68)m=	236.54	239	232.81	219.64	203.02	187.4	176.96	174.51	180.69	193.86	210.48	226.11	(68)

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

(69)m=	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	(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=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)

Water heating gains (Table 5)

(72)m=	115.85	114.06	110.35	105.3	102.03	97.41	93.49	98.52	100.3	105.52	111.42	114.07	(72)

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

(73)m=	471.8	468.52	452.76	428.35	403.57	381.09	367.71	374.23	388.06	412.65	440.04	460.56	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Northeast 0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

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

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

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

(84)m=	503.18	528.2	551	577.85	596.39	583.66	558.37	530.88	503.78	483.09	478.77	486.68	(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

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(86)m=	0.99	0.99	0.98	0.95	0.89	0.75	0.6	0.64	0.84	0.95	0.98	0.99	(86)

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

(87)m=	19.57	19.69	19.93	20.29	20.63	20.87	20.96	20.95	20.78	20.37	19.92	19.54	(87)

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

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

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

(89)m=	0.99	0.98	0.97	0.93	0.84	0.65	0.44	0.49	0.76	0.93	0.98	0.99	(89)

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

(90)m=	17.83	18.01	18.36	18.87	19.32	19.61	19.68	19.68	19.52	18.99	18.35	17.8	(90)

fLA = Living area ÷ (4) = 0.25 (91)

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

(92)m=	18.27	18.43	18.76	19.22	19.65	19.93	20	20	19.84	19.34	18.74	18.24	(92)

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

(93)m=	18.27	18.43	18.76	19.22	19.65	19.93	20	20	19.84	19.34	18.74	18.24	(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	0.97	0.96	0.92	0.84	0.67	0.48	0.53	0.77	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	493.15	514.45	528.47	532.26	498.22	389.66	267.31	278.75	388.38	446.18	463.87	478.11	(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=	1155.59	1117.34	1010.41	843.37	648.39	430.65	275.12	290.2	465.43	712.67	952.61	1153.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	492.85	405.14	358.56	224	111.73	0	0	0	0	198.27	351.9	502.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2644.61 (98)

Space heating requirement in kWh/m²/year 48.67 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.71	0.8	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	542.27	478.02	468.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	617.86	590.56	557.32	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	0	83.73	65.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 149.67 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	0.7 (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) = 0 (106)

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

(107)m=	0	0	0	0	0	0	14.64	11.53	0	0	0	0

Total = Sum(107) = 26.17 (107)

Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.48	(108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2644.61	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	360.99	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2415.86	(307b)
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		1868.29	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	255.02	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1706.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.39	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.54	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		90.49	(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) =	90.49	(331)

Energy for lighting (calculated in Appendix L)	249.52	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	10.72	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	102.43	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	7.57	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	72.36	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	0.73	(348)
Pumps and fans	(331)	13.19	x 0.01 =	11.94	(349)
Energy for lighting	(332)	13.19	x 0.01 =	32.91	(350)
Additional standing charges (Table 12)				120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =			358.67	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.52	(357)
SAP rating (section12)		78.85	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	573	x	0.22		123.77	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	175.34	x	0.52		-91	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	0.22		87.44	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	0.52		-64.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	920.86	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.59	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1001.37	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1001.37	(376)
CO2 associated with space cooling	(315) x			0.52	=	2.87	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	46.97	(378)

CO2 associated with electricity for lighting	(332))) x		0.52	=	129.5	(379)
Total CO2, kg/year	sum of (376)…(382) =				1180.71	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				21.73	(384)
EI rating (section 14)					84.07	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	573	x	1.22		699.06	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	175.34	x	3.07		-538.29	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	1.22		493.85	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	3.07		-380.27	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	5201.13	(368)
Electrical energy for heat distribution	[(313) x				=	145.47	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5620.95	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5620.95	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5620.95	(376)
Energy associated with space cooling	(315) x			3.07	=	17	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	277.81	(378)
Energy associated with electricity for lighting	(332))) x			3.07	=	766.03	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =					6681.8	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.59	(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

SAP 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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (36)

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

SAP WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 69.75 (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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87

Average = $Sum(39)_{1...12}$ /12= 81.42 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09

Total = $Sum(44)_{1...12}$ = 939.13 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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)

SAP 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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91

Output from water heater (annual)$_{1...12}$ — 1882.19 (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=	86.67	77.07	82.53	76.2	76.27	70.45	69.85	73.63	72.55	78.9	80.65	85.33	(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=	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	(66)

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

(67)m=	36.05	32.02	26.04	19.71	14.74	12.44	13.44	17.47	23.45	29.78	34.76	37.05	(67)

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

(68)m=	241.43	243.93	237.62	224.18	207.21	191.27	180.62	178.11	184.42	197.86	214.83	230.77	(68)

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

(69)m=	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	116.49	114.68	110.93	105.83	102.51	97.85	93.88	98.96	100.77	106.05	112.02	114.69	(72)

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

(73)m=	479.06	475.73	459.68	434.81	409.55	386.65	373.03	379.64	393.74	418.79	446.69	467.61	(73)

6. Solar gains:

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

SAP 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	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

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

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

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

(84)m=	510.44	535.42	557.92	584.32	602.37	589.22	563.69	536.28	509.46	489.22	485.41	493.73	(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	0.99	0.98	0.95	0.89	0.75	0.59	0.64	0.84	0.95	0.98	0.99	(86)

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

(87)m=	19.61	19.73	19.97	20.31	20.64	20.88	20.97	20.95	20.79	20.39	19.95	19.59	(87)

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

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

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

(89)m=	0.99	0.98	0.97	0.93	0.84	0.65	0.44	0.49	0.76	0.93	0.98	0.99	(89)

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

(90)m=	17.91	18.09	18.43	18.93	19.37	19.65	19.71	19.71	19.56	19.05	18.41	17.88	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

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

(92)m=	18.35	18.51	18.83	19.28	19.7	19.96	20.04	20.03	19.88	19.39	18.81	18.32	(92)

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

(93)m=	18.35	18.51	18.83	19.28	19.7	19.96	20.04	20.03	19.88	19.39	18.81	18.32	(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	0.97	0.96	0.92	0.84	0.67	0.48	0.52	0.77	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	500.55	521.82	535.56	538.76	503.56	393.11	269.6	281.23	392.67	452.22	470.63	485.3	(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=	1157.97	1119.68	1012.6	845.56	650.25	432.45	276.94	292.05	467.37	715	955.26	1155.84	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	489.12	401.76	354.92	220.9	109.13	0	0	0	0	195.51	348.93	498.89	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2619.15 | (98)

Space heating requirement in kWh/m²/year | 47.1 | (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.77	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	546.9	481.43	472.55	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	623.42	595.88	562.73	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	0	85.15	67.09	0	0	0	0

Total = Sum(104) = 152.24 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.68 (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) = 0 (106)

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

(107)m=	0	0	0	0	0	0	14.55	11.46	0	0	0	0

Total = Sum(107) = 26.01 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.47 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2619.15	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	357.51	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2392.6	(307b)
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		1882.19	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	256.92	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1719.38	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.26	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)

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Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.5	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		92.61	(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) =	92.61	(331)
Energy for lighting (calculated in Appendix L)		254.67	(332)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	10.62	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	101.45	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	7.63	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	72.9	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	0.73	(348)
Pumps and fans	(331)		13.19	x 0.01 =	12.21	(349)
Energy for lighting	(332)		13.19	x 0.01 =	33.59	(350)
Additional standing charges (Table 12)					120	(351)
Total energy cost	= (340a)…(342e) + (345)…(354) =				359.13	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.5	(357)
SAP rating (section12)		79.09	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	567.48	x	0.22		122.58	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	173.65	x	0.52		-90.12	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	0.22		88.09	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	0.52		-64.77	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	918.5	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.53	(372)

Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	998.8	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				998.8	(376)
CO2 associated with space cooling	(315) x		0.52	=	2.86	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	48.06	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	132.18	(379)
Total CO2, kg/year	sum of (376)…(382) =				1181.9	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				21.25	(384)
EI rating (section 14)					84.26	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	567.48	x	1.22		692.33	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	173.65	x	3.07		-533.11	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	1.22		497.53	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	3.07		-383.1	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	5187.82	(368)
Electrical energy for heat distribution	[(313) x				=	145.1	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5606.56	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5606.56	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5606.56	(376)
Energy associated with space cooling	(315) x			3.07	=	16.9	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	284.3	(378)
Energy associated with electricity for lighting	(332))) x			3.07	=	781.85	(379)
Total Primary Energy, kWh/year	sum of (376)…(382) =					6689.62	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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

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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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		36.66	(36)

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

Total fabric heat loss	(33) + (36) =	107.78	(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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

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

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = Sum(39)$_{1…12}$ /12= 133.24 (39)

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

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = Sum(40)$_{1…12}$ /12= 1.24 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68

Total = Sum(44)$_{1…12}$ = 1207.41 (44)

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

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96

Total = Sum(45)$_{1…12}$ = 1583.1 (45)

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

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

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

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:
a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)
Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =		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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23	(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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23

Output from water heater (annual)1…12 — 2233.94 (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=	98.8	87.67	93.48	85.74	85.42	78.35	77.17	82.03	81.05	88.81	91.47	97.07	(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=	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	167.79	(66)

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

(67)m=	59.59	52.93	43.05	32.59	24.36	20.57	22.22	28.89	38.77	49.23	57.46	61.25	(67)

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

(68)m=	399.08	403.22	392.78	370.57	342.52	316.16	298.56	294.41	304.85	327.07	355.11	381.47	(68)

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

(69)m=	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	54.58	(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=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

Water heating gains (Table 5)

(72)m=	132.79	130.47	125.64	119.08	114.82	108.82	103.72	110.25	112.57	119.37	127.03	130.48	(72)

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

(73)m=	701.97	697.12	671.97	632.74	592.21	556.06	535.01	544.06	566.7	606.17	650.11	683.7	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast	0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast	0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast	0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast	0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast	0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast	0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast	0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast	0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast	0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast	0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast	0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast	0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast	0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast	0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast	0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast	0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast	0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast	0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast	0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast	0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast	0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast	0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast	0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast	0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast	0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast	0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast	0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast	0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast	0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast	0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast	0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast 0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast 0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast 0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast 0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast 0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast 0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast 0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast 0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast 0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast 0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast 0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast 0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast 0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast 0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast 0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest 0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest 0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest 0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest 0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest 0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest 0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest 0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest 0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest 0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest 0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest 0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest 0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

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

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

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

(84)m=	770.81	821.52	861.16	898.96	919.42	893.67	855.19	816.79	782.26	748.77	733.86	741.77	(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	0.97	0.92	0.8	0.64	0.68	0.88	0.97	0.99	1	(86)

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

(87)m=	19.72	19.83	20.05	20.36	20.67	20.89	20.97	20.96	20.81	20.44	20.03	19.7	(87)

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

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

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

(89)m=	0.99	0.99	0.98	0.96	0.89	0.71	0.5	0.55	0.82	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=	18.18	18.35	18.67	19.12	19.54	19.82	19.89	19.88	19.73	19.24	18.64	18.16	(90)

fLA = Living area ÷ (4) = 0.15 (91)

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

(92)m=	18.4	18.57	18.87	19.31	19.71	19.98	20.05	20.04	19.89	19.41	18.85	18.38	(92)

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

(93)m=	18.4	18.57	18.87	19.31	19.71	19.98	20.05	20.04	19.89	19.41	18.85	18.38	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.88	0.72	0.52	0.57	0.82	0.95	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	764.09	811.05	841.82	854.42	809.22	641.82	442.49	461.6	639.01	713.58	722.85	736.33	(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=	1911.48	1847.76	1668.75	1387.27	1064.92	706.81	453.01	477.53	764.89	1171.98	1569.68	1904	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	853.66	696.67	615.23	383.65	190.24	0	0	0	0	341.05	609.72	868.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4558.96 (98)

Space heating requirement in kWh/m²/year 42.55 (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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 4558.96

Space heat from Community CHP (98) x (304a) x (305) x (306) = 622.3 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4164.61	(307b)
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		2233.94	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	304.93	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2040.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	71.33	(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		247.21	(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) =	247.21	(331)
Energy for lighting (calculated in Appendix L)		420.97	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-228.98	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	18.48	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	176.58	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	9.06	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	86.53	(342b)
			Fuel Price			
Pumps and fans	(331)		13.19	x 0.01 =	32.61	(349)
Energy for lighting	(332)		13.19	x 0.01 =	55.53	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies Item 1			13.19	x 0.01 =	-30.2	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				468.58	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.29	(357)
SAP rating (section12)		81.95	(358)

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12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	987.78	x	0.22		213.36	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	302.26	x	0.52		-156.87	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	484.02	x	0.22		104.55	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.11	x	0.52		-76.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1386.09	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	37.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1507.27	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1507.27	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	128.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	218.48	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-118.84	(380)
Total CO2, kg/year	sum of (376)…(382) =					1735.22	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					16.2	(384)
EI rating (section 14)						84.72	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	987.78	x	1.22		1205.09	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	302.26	x	3.07		-927.94	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	484.02	x	1.22		590.51	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.11	x	3.07		-454.7	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	7828.84	(368)
Electrical energy for heat distribution	[(313) x				=	218.97	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	8460.77	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						8460.77	(373)

SAP WorkSheet: New dwelling design stage

Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			8460.77	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	758.92	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1292.39	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-702.96	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =			9809.12	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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

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Wind Factor (22a)m = (22)m ÷ 4

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

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

0.15	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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

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

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86	(38)

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

(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37	

Average = Sum(39)$_{1…12}$ /12= 133.41 (39)

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

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	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 — 2.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 101.09 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2	

Total = Sum(44)$_{1…12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7	

Total = Sum(45)$_{1…12}$ = 1590.57 (45)

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

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98	(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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98

Output from water heater (annual)$_{1...12}$ — 2241.41 (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=	99.05	87.9	93.71	85.94	85.62	78.52	77.32	82.21	81.23	89.02	91.69	97.32	(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=	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	168.99	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	60.61	53.84	43.78	33.15	24.78	20.92	22.6	29.38	39.43	50.07	58.44	62.3	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	405.91	410.12	399.5	376.91	348.38	321.58	303.67	299.45	310.07	332.66	361.19	388	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	54.72	(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=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

Water heating gains (Table 5)

(72)m=	133.14	130.8	125.95	119.36	115.08	109.05	103.93	110.49	112.83	119.65	127.35	130.81	(72)

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

(73)m=	710.7	705.8	680.28	640.46	599.29	562.59	541.24	550.37	573.37	613.43	658.03	692.15	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast 0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast 0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast 0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest 0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest 0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest 0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest 0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest 0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest 0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest 0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest 0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest 0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest 0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest 0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest 0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest 0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest 0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest 0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest 0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest 0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest 0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest 0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest 0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest 0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest 0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest 0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest 0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

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

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

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

(84)m=	769.12	813.98	851.34	891.03	915.2	891.72	852.11	810.12	771.59	739.2	729.57	741.12	(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	0.97	0.93	0.81	0.64	0.69	0.89	0.98	0.99	1	(86)

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

(87)m=	19.74	19.85	20.06	20.37	20.67	20.89	20.97	20.96	20.81	20.44	20.04	19.72	(87)

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

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

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

(89)m=	0.99	0.99	0.99	0.96	0.89	0.72	0.5	0.56	0.83	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=	18.24	18.4	18.71	19.16	19.57	19.85	19.91	19.91	19.76	19.26	18.69	18.21	(90)

fLA = Living area ÷ (4) = 0.14 (91)

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

(92)m=	18.45	18.6	18.9	19.33	19.73	20	20.06	20.06	19.91	19.43	18.88	18.43	(92)

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

(93)m=	18.45	18.6	18.9	19.33	19.73	20	20.06	20.06	19.91	19.43	18.88	18.43	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.95	0.89	0.72	0.52	0.57	0.83	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	763.17	804.92	834.49	850.77	810.96	645.93	445.84	464.75	638.51	708.01	719.86	736.3	(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=	1918.15	1853.33	1673.4	1391.97	1069.2	710.74	456.18	480.77	768.26	1176	1575.8	1911.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	859.31	704.53	624.14	389.67	192.13	0	0	0	0	348.18	616.28	874.55	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 4608.78 (98)

Space heating requirement in kWh/m²/year 41.79 (99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		4608.78	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	629.1	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4210.12	(307b)
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		2241.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	305.95	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2047.53	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	71.93	(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		253.98	(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) =	253.98	(331)
Energy for lighting (calculated in Appendix L)		428.18	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-235.75	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	18.68	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	178.51	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	9.09	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	86.82	(342b)
			Fuel Price			
Pumps and fans	(331)		13.19	x 0.01 =	33.5	(349)
Energy for lighting	(332)		13.19	x 0.01 =	56.48	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies Item 1			13.19	x 0.01 =	-31.1	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				471.98	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.28	(357)
SAP rating (section12)		82.19	(358)

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12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	998.57	x	0.22		215.69	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	305.56	x	0.52		-158.59	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	0.22		104.9	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	0.52		-77.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1397.78	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	37.33	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1519.98	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1519.98	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	131.81	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	222.22	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-122.35	(380)
Total CO2, kg/year	sum of (376)…(382) =					1751.67	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					15.88	(384)
EI rating (section 14)						84.88	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	998.57	x	1.22		1218.25	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	305.56	x	3.07		-938.08	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	1.22		592.48	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	3.07		-456.22	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	7894.86	(368)
Electrical energy for heat distribution	[(313) x				=	220.82	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	8532.11	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						8532.11	(373)

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Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			8532.11	(376)
Energy associated with space cooling	(315) x	3.07	=	0	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	779.71	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1314.51	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-723.74	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =			9902.59	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27754.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 18.19 (36)

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

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = Sum(39)$_{1...12}$ /12= 74.07 (39)

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

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = Sum(44)$_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = Sum(45)$_{1...12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

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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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

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

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(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	0.97	0.93	0.82	0.64	0.47	0.51	0.75	0.93	0.98	0.99	(86)

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

(87)m=	20.16	20.26	20.45	20.69	20.89	20.98	21	21	20.95	20.73	20.41	20.14	(87)

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

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

(89)m=	0.99	0.98	0.96	0.91	0.77	0.55	0.37	0.41	0.67	0.91	0.97	0.99	(89)

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

(90)m=	18.97	19.12	19.38	19.73	19.98	20.08	20.1	20.1	20.05	19.78	19.34	18.95	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.28	19.42	19.66	19.98	20.22	20.32	20.33	20.33	20.29	20.03	19.62	19.26	(92)

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

(93)m=	19.28	19.42	19.66	19.98	20.22	20.32	20.33	20.33	20.29	20.03	19.62	19.26	(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	0.98	0.96	0.9	0.78	0.58	0.4	0.44	0.69	0.91	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	612.34	640.89	654.54	643.07	569.19	408.39	271.17	284.41	430.33	542.31	574.22	592.57	(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=	1131.72	1093.79	988.85	821.51	629.44	416.89	272.05	285.88	453.67	697.08	930.55	1125.41	(97)

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

(98)m=	386.42	304.34	248.73	128.48	44.83	0	0	0	0	115.15	256.56	396.43		
									Total per year (kWh/year) = Sum(98)1...5,9...12 =				1880.94	(98)
Space heating requirement in kWh/m²/year													25.4	(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	685.27	539.47	552.51	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.89	0.94	0.93	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	608.06	508.87	511.09	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	103.63	156.51	127.74	0	0	0	0		
									Total = Sum(104)6..8 =				387.89	(104)
Cooled fraction									f C = cooled area ÷ (4) =				0.6	(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	15.57	23.51	19.19	0	0	0	0		
									Total = Sum(107)6..8 =				58.27	(107)
Space cooling requirement in kWh/m²/year									(107) ÷ (4) =				0.79	(108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		1880.94	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	256.75	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1718.24	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	41.42	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.33	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	7.63	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	72.85	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	79.93	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	1.63	(348)
Pumps and fans	(331)		13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)		13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies Item 1			13.19	x 0.01 =	-20.87	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				333.35	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)

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Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.18	(357)
SAP rating (section12)		83.6	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	407.54	x	0.22		88.03	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	124.71	x	0.52		-64.72	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	804.87	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21.5	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	875.24	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					875.24	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.4	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =					1050.64	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					14.19	(384)
EI rating (section 14)						88.18	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	407.54	x	1.22		497.2	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	124.71	x	3.07		-382.85	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22		545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07		-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4546.04	(368)
Electrical energy for heat distribution	[(313) x				=	127.15	(372)

SAP WorkSheet: New dwelling design stage

Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	4912.98	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)				4912.98	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			4912.98	(376)
Energy associated with space cooling	(315) x	3.07	=	37.86	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	486.81	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	998.51	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-485.65	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =			5950.52	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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

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

0.15	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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

* *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) = 39.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27990.6 (34)

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

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

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 18.24 (36)

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

Total fabric heat loss — (33) + (36) = 57.66 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24

Average = Sum(39)$_{1…12}$ /12= 73.62 (39)

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

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98

Average = Sum(40)$_{1…12}$ /12= 0.97 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.38 (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 — 90.82 (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
(44)m=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

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

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	

Output from water heater (annual)$_{1...12}$ 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

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Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(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	0.97	0.93	0.82	0.63	0.46	0.5	0.74	0.93	0.98	0.99	(86)

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

(87)m=	20.2	20.3	20.48	20.71	20.9	20.98	21	21	20.96	20.75	20.44	20.18	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

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

(89)m=	0.99	0.98	0.96	0.9	0.77	0.55	0.37	0.41	0.67	0.91	0.97	0.99	(89)

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

(90)m=	19.05	19.19	19.45	19.78	20.02	20.11	20.12	20.12	20.08	19.83	19.41	19.03	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.34	19.48	19.71	20.02	20.24	20.33	20.35	20.35	20.31	20.07	19.67	19.32	(92)

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

(93)m=	19.34	19.48	19.71	20.02	20.24	20.33	20.35	20.35	20.31	20.07	19.67	19.32	(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	0.98	0.96	0.9	0.78	0.57	0.39	0.43	0.69	0.9	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	621.82	650.21	663.11	649.75	572.29	408.52	270.92	284.23	431.77	548.6	582.65	601.8	(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=	1128.3	1090.51	985.89	819.34	627.57	415.88	271.64	285.45	452.57	695.54	928.43	1122.57	(97)

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

(98)m=	376.82	295.88	240.15	122.1	41.13	0	0	0	0	109.32	248.96	387.45

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1821.82 (98)

Space heating requirement in kWh/m²/year 23.95 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	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	610.8	509.45	512.46	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	106.88	161.24	131.96	0	0	0	0

Total = Sum(104)$_{6...8}$ = 400.08 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	15.63	23.58	19.3	0	0	0	0

Total = Sum(107)$_{6...8}$ = 58.52 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.77 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 1821.82

Space heat from Community CHP (98) x (304a) x (305) x (306) = 248.68 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1664.23	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	40.97	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.38	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	7.39	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	70.56	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	80.55	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	1.63	(348)
Pumps and fans	(331)		13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)		13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies Item 1			13.19	x 0.01 =	-21.43	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				332.43	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

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Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =				1.15	(357)
SAP rating (section12)					83.91	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	394.73	x	0.22	85.26	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	120.79	x	0.52	-62.69	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22	97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52	-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	= 796.11	(368)
Electrical energy for heat distribution	[(313) x			0.52	= 21.26	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				= 865.71	(373)
CO2 associated with space heating (secondary)	(309) x			0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				865.71	(376)
CO2 associated with space cooling	(315) x			0.52	= 6.43	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	= 84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	= 172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =				1044.75	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				13.74	(384)
EI rating (section 14)					88.44	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Primary factor**	**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	394.73	x	1.22	481.57	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	120.79	x	3.07	-370.81	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22	549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07	-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	= 4496.56	(368)
Electrical energy for heat distribution	[(313) x				= 125.77	(372)

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Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	4859.51	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					4859.51	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				4859.51	(376)
Energy associated with space cooling	(315) x		3.07	=	38.02	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	1019.91	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =		-498.87	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =				5918.53	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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

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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) = 37.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27828.4 (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 11.04 (36)

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

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Total fabric heat loss (33) + (36) = 48.97 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = Sum(39)$_{1…12}$ /12= 65.3 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = Sum(40)$_{1…12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = Sum(44)$_{1…12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = Sum(45)$_{1…12}$ = 1412.71 (45)

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

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

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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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

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

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

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

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

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

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

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

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(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	0.9	0.77	0.57	0.41	0.45	0.69	0.91	0.98	0.99	(86)

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

(87)m=	20.34	20.43	20.6	20.8	20.94	20.99	21	21	20.98	20.82	20.56	20.32	(87)

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

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

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

(89)m=	0.98	0.97	0.95	0.88	0.72	0.5	0.34	0.37	0.62	0.88	0.97	0.99	(89)

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

(90)m=	19.3	19.44	19.67	19.96	20.13	20.19	20.2	20.2	20.18	19.99	19.62	19.28	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.57	19.7	19.91	20.18	20.34	20.4	20.41	20.41	20.39	20.21	19.87	19.55	(92)

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

(93)m=	19.57	19.7	19.91	20.18	20.34	20.4	20.41	20.41	20.39	20.21	19.87	19.55	(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	0.97	0.95	0.88	0.73	0.52	0.36	0.39	0.64	0.88	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	610.65	637.77	647.51	624.44	533.14	369.15	243.92	255.84	395.74	527.34	570.3	591.24	(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=	1019.54	985.02	890.14	737.34	563.16	372.11	244.15	256.26	405.7	626.16	837.01	1012.47	(97)

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

(98)m=	304.21	233.35	180.52	81.29	22.33	0	0	0	0	73.52	192.03	313.39

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1400.63 (98)

Space heating requirement in kWh/m²/year 18.91 (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	602.87	474.6	485.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.25	462.49	468.37	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	133.74	191.02	159.52	0	0	0	0

Total = $Sum(104)_{6...8}$ = 484.28 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	20.09	28.69	23.96	0	0	0	0

Total = $Sum(107)_{6...8}$ = 72.75 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.98 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		1400.63	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	191.19	(307a)

Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1279.47	(307b)
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		2063.55	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	36.37	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.4	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	5.68	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	54.25	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	79.93	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	2.03	(348)
Pumps and fans	(331)	13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)	13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies					
Item 1		13.19	x 0.01 =	-20.87	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =			313.2	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =				1.1	(357)
SAP rating (section12)					84.59	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	303.47	x	0.22	65.55	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	92.86	x	0.52	-48.2	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22	96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52	-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	= 706.86	(368)
Electrical energy for heat distribution	[(313) x			0.52	= 18.88	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				= 768.66	(373)
CO2 associated with space heating (secondary)	(309) x			0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				768.66	(376)
CO2 associated with space cooling	(315) x			0.52	= 7.99	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	= 82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	= 168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52 x 0.01 =	-82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =				945.66	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				12.77	(384)
EI rating (section 14)					89.36	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Primary factor**	**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	303.47	x	1.22	370.23	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	92.86	x	3.07	-285.09	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22	545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07	-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	= 3992.47	(368)
Electrical energy for heat distribution	[(313) x				= 111.67	(372)

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Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	4314.74	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					4314.74	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				4314.74	(376)
Energy associated with space cooling	(315) x		3.07	=	47.27	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	486.81	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	998.51	(379)
Energy saving/generation technologies						
Item 1		3.07		x 0.01 =	-485.65	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =				5361.68	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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

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

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) = 76.5 (23c)

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

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) = 37.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28062.4 (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 (36)

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

Total fabric heat loss (33) + (36) = 48.84 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

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

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = $Sum(39)_{1...12}$ /12= 64.8 (39)

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

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = $Sum(40)_{1...12}$ /12= 0.85 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = 1428.9 (45)

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

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)

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

(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)

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

(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)

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

(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

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

(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

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

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

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

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(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	0.9	0.76	0.56	0.41	0.44	0.68	0.91	0.97	0.99	(86)

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

(87)m=	20.37	20.47	20.62	20.82	20.95	20.99	21	21	20.98	20.84	20.58	20.35	(87)

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

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

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

(89)m=	0.98	0.97	0.95	0.87	0.71	0.5	0.34	0.37	0.61	0.88	0.97	0.99	(89)

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

(90)m=	19.37	19.51	19.73	20.01	20.16	20.22	20.22	20.22	20.2	20.04	19.69	19.35	(90)

fLA = Living area ÷ (4) = 0.26 (91)

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

(92)m=	19.63	19.75	19.96	20.22	20.37	20.42	20.42	20.42	20.4	20.24	19.92	19.61	(92)

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

(93)m=	19.63	19.75	19.96	20.22	20.37	20.42	20.42	20.42	20.4	20.24	19.92	19.61	(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	0.97	0.95	0.87	0.72	0.51	0.35	0.39	0.63	0.88	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	619.92	646.73	655.34	629.43	533.92	368.11	243.17	255.1	395.47	532.19	578.3	600.31	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1014.49	980.17	885.73	733.89	560.3	370.53	243.35	255.42	403.9	623.51	833.54	1008.02	(97)

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

(98)m=	293.56	224.07	171.41	75.21	19.62	0	0	0	0	67.94	183.77	303.34

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1338.92 (98)

Space heating requirement in kWh/m²/year 17.6 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.98	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.6	461.21	467.74	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	138.71	197.13	165.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 501.07 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	20.29	28.83	24.17	0	0	0	0

Total = Sum(107)$_{6...8}$ = 73.29 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.96 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 1338.92

Space heat from Community CHP (98) x (304a) x (305) x (306) = 182.76 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1223.1	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	35.9	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.51	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	5.43	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	51.86	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	80.55	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	2.05	(348)
Pumps and fans	(331)	13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)	13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies Item 1		13.19	x 0.01 =	-21.43	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =			312.18	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

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Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =				1.08	(357)
SAP rating (section12)					84.89	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	290.1	x	0.22		62.66	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	88.77	x	0.52		-46.07	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	697.58	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	18.63	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	758.56	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					758.56	(376)
CO2 associated with space cooling	(315) x			0.52	=	8.05	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =					939.22	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					12.35	(384)
EI rating (section 14)						89.6	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	290.1	x	1.22		353.92	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	88.77	x	3.07		-272.52	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22		549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07		-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	3940.01	(368)
Electrical energy for heat distribution	[(313) x				=	110.2	(372)

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Total Energy associated with community systems	(363)…(366) + (368)...(372)			=	4258.04	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)					4258.04	(373)
Energy associated with space heating (secondary)	(309) x		0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x		1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =				4258.04	(376)
Energy associated with space cooling	(315) x		3.07	=	47.62	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x		3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x		3.07	=	1019.91	(379)
Energy saving/generation technologies Item 1		3.07		x 0.01 =	-498.87	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =				5326.65	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) = 76.5 (23c)

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

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

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

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

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

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = $Sum(39)_{1...12}$ /12= 80.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09	

Average = $Sum(40)_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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)

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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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	140.43	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	46.04	40.89	33.26	25.18	18.82	15.89	17.17	22.32	29.95	38.03	44.39	47.32	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	308.33	311.53	303.47	286.3	264.64	244.27	230.67	227.47	235.53	252.7	274.36	294.73	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	51.38	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	577.46	573.44	553.43	522.33	490.51	461.86	444.99	452.76	470.53	501.84	536.71	563.07	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	622.79	656.94	684.4	712.62	729.21	710.09	679.62	649.56	621.77	598.64	592.15	601.12	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.5	0.55	0.78	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.05	20.15	20.35	20.61	20.84	20.97	20.99	20.99	20.92	20.66	20.31	20.03	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.44	0.71	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.76	18.91	19.19	19.57	19.87	20.01	20.03	20.03	19.97	19.64	19.15	18.73	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.24	19.49	19.85	20.12	20.26	20.28	20.28	20.22	19.91	19.46	19.07	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.24	19.49	19.85	20.12	20.26	20.28	20.28	20.22	19.91	19.46	19.07	(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	0.98	0.96	0.91	0.81	0.61	0.42	0.47	0.72	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	612.97	642.13	657.44	651.26	587.23	431.69	288.54	302.43	449.1	548.84	575.78	593.05	(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=	1205.77	1165.52	1053.8	876.6	672.69	446.3	290.31	305.28	484.96	743.42	992.13	1199.96	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	441.04	351.72	294.89	162.24	63.58	0	0	0	0	144.77	299.77	451.54

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2209.56 (98)

Space heating requirement in kWh/m²/year 29.83 (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	628.97	534.61	533.86	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	88.58	137.36	110.8	0	0	0	0

Total = Sum(104)$_{6...8}$ = 336.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	13.31	20.63	16.64	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.68 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2209.56	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	301.6	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2018.43	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.87	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.71	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	8.96	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	85.58	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.37	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	79.93	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	1.41	(348)
Pumps and fans	(331)	13.19	x 0.01 =	20.92	(349)
Energy for lighting	(332)	13.19	x 0.01 =	42.9	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies Item 1		13.19	x 0.01 =	-20.87	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =			347.19	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

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Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =				1.22	(357)
SAP rating (section12)					82.91	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	478.74	x	0.22	103.41	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	146.49	x	0.52	-76.03	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22	96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52	-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	= 871.93	(368)
Electrical energy for heat distribution	[(313) x			0.52	= 23.29	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				= 948.16	(373)
CO2 associated with space heating (secondary)	(309) x			0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				948.16	(376)
CO2 associated with space cooling	(315) x			0.52	= 5.56	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	= 82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	= 168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 = -82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =				1122.71	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				15.16	(384)
EI rating (section 14)					87.36	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Primary factor**	**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	478.74	x	1.22	584.06	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	146.49	x	3.07	-449.74	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	1.22	545.46	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	3.07	-420.02	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	= 4924.77	(368)
Electrical energy for heat distribution	[(313) x				= 137.74	(372)

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Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	5322.28	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)				5322.28	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			5322.28	(376)
Energy associated with space cooling	(315) x	3.07	=	32.87	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	486.81	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	998.51	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-485.65	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =			6354.82	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	76.06	(1a)	x	2.6	(2a)	=	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			197.76	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26201.45 (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 | 23.27 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 64.17 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75

Average = $Sum(39)_{1...12}$ /12= | 80.13 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06

Average = $Sum(40)_{1...12}$ /12= | 1.05 | (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 | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = | 1428.9 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1…12}$ — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	143.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	47.03	41.77	33.97	25.72	19.22	16.23	17.54	22.8	30.6	38.85	45.34	48.34	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	314.94	318.21	309.97	292.44	270.31	249.51	235.61	232.34	240.58	258.11	280.24	301.04	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	51.69	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	586.98	582.89	562.5	530.79	498.32	469.11	451.92	459.81	477.94	509.85	545.4	572.3	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	632.31	666.4	693.47	721.08	737.03	717.34	686.56	656.6	629.18	606.65	600.84	610.35	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.5	0.54	0.78	0.94	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.18	20.37	20.63	20.85	20.97	20.99	20.99	20.93	20.67	20.34	20.06	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.44	0.7	0.92	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.82	18.97	19.24	19.61	19.9	20.03	20.05	20.05	19.99	19.68	19.2	18.79	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.14	19.28	19.53	19.87	20.14	20.27	20.29	20.29	20.23	19.93	19.49	19.12	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.14	19.28	19.53	19.87	20.14	20.27	20.29	20.29	20.23	19.93	19.49	19.12	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.91	0.8	0.61	0.42	0.46	0.72	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	622.58	651.67	666.51	659.26	592.98	434.6	290.12	304.19	453.11	556.23	584.49	602.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1209.67	1169.35	1057.27	879.88	675.13	448.18	291.7	306.76	486.99	746.49	996.1	1204.48	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	436.8	347.88	290.73	158.85	61.12	0	0	0	0	141.56	296.36	447.97

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2181.26 (98)

Space heating requirement in kWh/m²/year 28.68 (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	743.01	584.92	599.29	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	634.58	538.46	538.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	89.76	139.66	112.76	0	0	0	0

Total = $Sum(104)_{6...8}$ = 342.18 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	13.13	20.43	16.49	0	0	0	0

Total = $Sum(107)_{6...8}$ = 50.05 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.66 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 2181.26

Space heat from Community CHP (98) x (304a) x (305) x (306) = 297.74 (307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1992.58	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.74	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.59	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating from CHP	(307a) x	2.97	x 0.01 =	8.84	(340a)
Space heating from heat source 2	(307b) x	4.24	x 0.01 =	84.49	(340b)
Water heating from CHP	(310a) x	2.97	x 0.01 =	8.43	(342a)
Water heating from heat source 2	(310b) x	4.24	x 0.01 =	80.55	(342b)
		Fuel Price			
Space cooling (community cooling system)	(315)	13.19	x 0.01 =	1.4	(348)
Pumps and fans	(331)	13.19	x 0.01 =	21.48	(349)
Energy for lighting	(332)	13.19	x 0.01 =	43.82	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies Item 1		13.19	x 0.01 =	-21.43	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =			347.58	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)	0.42	(356)

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Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =					1.21	(357)
SAP rating (section12)						83.18	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	472.61	x	0.22		102.08	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	144.62	x	0.52		-75.06	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	869.46	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	23.22	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	945.47	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					945.47	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.5	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52	x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =					1123.57	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					14.77	(384)
EI rating (section 14)						87.56	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	472.61	x	1.22		576.58	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	144.62	x	3.07		-443.98	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	1.22		549.74	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	3.07		-423.31	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	4910.81	(368)
Electrical energy for heat distribution	[(313) x				=	137.35	(372)

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Total Energy associated with community systems	(363)…(366) + (368)...(372)		=	5307.2	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)				5307.2	(373)
Energy associated with space heating (secondary)	(309) x	0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =			5307.2	(376)
Energy associated with space cooling	(315) x	3.07	=	32.52	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	499.96	(378)
Energy associated with electricity for lighting	(332))) x	3.07	=	1019.91	(379)
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-498.87	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =			6360.72	(383)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	54.34	(1a)	x	2.6	(2a)	=	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			141.28	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 69.69 (37)

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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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = $Sum(39)_{1...12}$ /12= 81.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51	

Average = $Sum(40)_{1...12}$ /12= 1.5 (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 1.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12	

Total = $Sum(44)_{1...12}$ = 928.53 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24	

Total = $Sum(45)_{1...12}$ = 1217.45 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52

Output from water heater (annual)$_{1...12}$ — 1868.29 (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=	86.19	76.65	82.1	75.82	75.91	70.14	69.56	73.3	72.22	78.51	80.22	84.87	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	109.08	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	35.32	31.37	25.51	19.32	14.44	12.19	13.17	17.12	22.98	29.18	34.05	36.3	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	236.54	239	232.81	219.64	203.02	187.4	176.96	174.51	180.69	193.86	210.48	226.11	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	47.73	(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=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)

Water heating gains (Table 5)

(72)m=	115.85	114.06	110.35	105.3	102.03	97.41	93.49	98.52	100.3	105.52	111.42	114.07	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	471.8	468.52	452.76	428.35	403.57	381.09	367.71	374.23	388.06	412.65	440.04	460.56	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

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Northeast 0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest 0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest 0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest 0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest 0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest 0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest 0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest 0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest 0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest 0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest 0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest 0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest 0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest 0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest 0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest 0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest 0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest 0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest 0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest 0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest 0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest 0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest 0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest 0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest 0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	503.18	528.2	551	577.85	596.39	583.66	558.37	530.88	503.78	483.09	478.77	486.68	(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

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(86)m=	0.99	0.99	0.98	0.95	0.89	0.75	0.6	0.64	0.84	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.57	19.69	19.93	20.29	20.63	20.87	20.96	20.95	20.78	20.37	19.92	19.54	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.84	0.65	0.44	0.49	0.76	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.01	18.36	18.87	19.32	19.61	19.68	19.68	19.52	18.99	18.35	17.8	(90)

fLA = Living area ÷ (4) = 0.25 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.27	18.43	18.76	19.22	19.65	19.93	20	20	19.84	19.34	18.74	18.24	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.27	18.43	18.76	19.22	19.65	19.93	20	20	19.84	19.34	18.74	18.24	(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	0.97	0.96	0.92	0.84	0.67	0.48	0.53	0.77	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	493.15	514.45	528.47	532.26	498.22	389.66	267.31	278.75	388.38	446.18	463.87	478.11	(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=	1155.59	1117.34	1010.41	843.37	648.39	430.65	275.12	290.2	465.43	712.67	952.61	1153.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	492.85	405.14	358.56	224	111.73	0	0	0	0	198.27	351.9	502.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2644.61 (98)

Space heating requirement in kWh/m²/year 48.67 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.71	0.8	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	542.27	478.02	468.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	617.86	590.56	557.32	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	0	83.73	65.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 149.67 (104)

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Cooled fraction	f C = cooled area ÷ (4) =	0.7 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.64	11.53	0	0	0	0

Total = Sum(107) = 26.17 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.48 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2644.61	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	360.99	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2415.86	(307b)
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		1868.29	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	255.02	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1706.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.39	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.54	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		90.49	(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) =	90.49	(331)

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Energy for lighting (calculated in Appendix L)	249.52	(332)
Electricity generated by PVs (Appendix M) (negative quantity)	-116.33	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)	0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	10.72	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	102.43	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	7.57	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	72.36	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	0.73	(348)
Pumps and fans	(331)		13.19	x 0.01 =	11.94	(349)
Energy for lighting	(332)		13.19	x 0.01 =	32.91	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies Item 1			13.19	x 0.01 =	-15.34	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				343.32	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.45	(357)
SAP rating (section12)		79.75	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	573	x	0.22		123.77	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	175.34	x	0.52		-91	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	0.22		87.44	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	0.52		-64.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	920.86	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.59	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1001.37	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)

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CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			1001.37	(376)
CO2 associated with space cooling	(315) x	0.52	=	2.87	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	46.97	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	129.5	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-60.38	(380)
Total CO2, kg/year	sum of (376)…(382) =			1120.33	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			20.62	(384)
EI rating (section 14)				84.89	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	573	x	1.22		699.06	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	175.34	x	3.07		-538.29	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	1.22		493.85	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	3.07		-380.27	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	5201.13	(368)
Electrical energy for heat distribution	[(313) x				=	145.47	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5620.95	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5620.95	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5620.95	(376)
Energy associated with space cooling	(315) x			3.07	=	17	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	277.81	(378)
Energy associated with electricity for lighting	(332))) x			3.07	=	766.03	(379)
Energy saving/generation technologies Item 1				3.07	x 0.01 =	-357.15	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =					6324.65	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	55.61	(1a)	x	2.6	(2a)	=	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	144.59	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss (33) + (36) = 69.75 (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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87	

Average = $Sum(39)_{1...12}$ /12= 81.42 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09	

Total = $Sum(44)_{1...12}$ = 939.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64	

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91

Output from water heater (annual)$_{1...12}$ — 1882.19 (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=	86.67	77.07	82.53	76.2	76.27	70.45	69.85	73.63	72.55	78.9	80.65	85.33	(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=	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	111.31	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	36.05	32.02	26.04	19.71	14.74	12.44	13.44	17.47	23.45	29.78	34.76	37.05	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	241.43	243.93	237.62	224.18	207.21	191.27	180.62	178.11	184.42	197.86	214.83	230.77	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	47.99	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	116.49	114.68	110.93	105.83	102.51	97.85	93.88	98.96	100.77	106.05	112.02	114.69	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	479.06	475.73	459.68	434.81	409.55	386.65	373.03	379.64	393.74	418.79	446.69	467.61	(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	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	510.44	535.42	557.92	584.32	602.37	589.22	563.69	536.28	509.46	489.22	485.41	493.73	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.75	0.59	0.64	0.84	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.61	19.73	19.97	20.31	20.64	20.88	20.97	20.95	20.79	20.39	19.95	19.59	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.84	0.65	0.44	0.49	0.76	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.91	18.09	18.43	18.93	19.37	19.65	19.71	19.71	19.56	19.05	18.41	17.88	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.35	18.51	18.83	19.28	19.7	19.96	20.04	20.03	19.88	19.39	18.81	18.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.35	18.51	18.83	19.28	19.7	19.96	20.04	20.03	19.88	19.39	18.81	18.32	(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	0.97	0.96	0.92	0.84	0.67	0.48	0.52	0.77	0.92	0.97	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	500.55	521.82	535.56	538.76	503.56	393.11	269.6	281.23	392.67	452.22	470.63	485.3	(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=	1157.97	1119.68	1012.6	845.56	650.25	432.45	276.94	292.05	467.37	715	955.26	1155.84	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	489.12	401.76	354.92	220.9	109.13	0	0	0	0	195.51	348.93	498.89	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = | 2619.15 | (98)

Space heating requirement in kWh/m²/year | 47.1 | (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.77	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	546.9	481.43	472.55	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	623.42	595.88	562.73	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	0	85.15	67.09	0	0	0	0

Total = Sum(104) = 152.24 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.68 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.55	11.46	0	0	0	0

Total = Sum(107) = 26.01 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.47 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2619.15	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	357.51	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2392.6	(307b)
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		1882.19	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	256.92	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1719.38	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.26	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)

Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.5	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		92.61	(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) =	92.61	(331)
Energy for lighting (calculated in Appendix L)		254.67	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-118.8	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year		Fuel Price (Table 12)		Fuel Cost £/year	
Space heating from CHP	(307a)	x	2.97	x 0.01 =	10.62	(340a)
Space heating from heat source 2	(307b)	x	4.24	x 0.01 =	101.45	(340b)
Water heating from CHP	(310a)	x	2.97	x 0.01 =	7.63	(342a)
Water heating from heat source 2	(310b)	x	4.24	x 0.01 =	72.9	(342b)
			Fuel Price			
Space cooling (community cooling system)	(315)		13.19	x 0.01 =	0.73	(348)
Pumps and fans	(331)		13.19	x 0.01 =	12.21	(349)
Energy for lighting	(332)		13.19	x 0.01 =	33.59	(350)
Additional standing charges (Table 12)					120	(351)
Energy saving/generation technologies						
Item 1			13.19	x 0.01 =	-15.67	(352)
Total energy cost	= (340a)…(342e) + (345)…(354) =				343.46	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =	1.43	(357)
SAP rating (section12)		80	(358)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	567.48	x	0.22	122.58	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	173.65	x	0.52	-90.12	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	0.22	88.09	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	0.52	-64.77	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)

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CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	918.5	(368)
Electrical energy for heat distribution	[(313) x	0.52	=	24.53	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	998.8	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			998.8	(376)
CO2 associated with space cooling	(315) x	0.52	=	2.86	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	48.06	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	132.18	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-61.66	(380)
Total CO2, kg/year	sum of (376)…(382) =			1120.24	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			20.14	(384)
EI rating (section 14)				85.08	(385)

13b. Primary Energy – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Primary factor**		**P.Energy kWh/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	567.48	x	1.22		692.33	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	173.65	x	3.07		-533.11	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	1.22		497.53	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	3.07		-383.1	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
Energy associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			1.22	=	5187.82	(368)
Electrical energy for heat distribution	[(313) x				=	145.1	(372)
Total Energy associated with community systems	(363)…(366) + (368)...(372)				=	5606.56	(373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)						5606.56	(373)
Energy associated with space heating (secondary)	(309) x			0	=	0	(374)
Energy associated with water from immersion heater or instantaneous heater	(312) x			1.22	=	0	(375)
Total Energy associated with space and water heating	(373) + (374) + (375) =					5606.56	(376)
Energy associated with space cooling	(315) x			3.07	=	16.9	(377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x			3.07	=	284.3	(378)
Energy associated with electricity for lighting	(332))) x			3.07	=	781.85	(379)
Energy saving/generation technologies Item 1				3.07	x 0.01 =	-364.71	(380)
Total Primary Energy, kWh/year	sum of (376)…(382) =					6324.91	(383)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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

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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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 — 36.66 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss — (33) + (36) = — 107.78 (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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = $Sum(39)_{1\ldots12}$ /12= 133.24 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = $Sum(40)_{1\ldots12}$ /12= 1.24 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68	

Total = $Sum(44)_{1\ldots12}$ = 1207.41 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96	

Total = $Sum(45)_{1\ldots12}$ = 1583.1 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)
Water storage loss calculated for each month	((56)m = (55) × (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=	50.96	46.03	50.96	48.63	48.2	44.66	46.15	48.2	48.63	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91	(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=	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91

Output from water heater (annual)$_{1...12}$ — 2166.73 (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=	67.31	59.24	61.99	55.1	53.25	46.72	44.48	49.86	50.42	57.33	61	65.59	(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=	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	23.84	21.17	17.22	13.04	9.74	8.23	8.89	11.55	15.51	19.69	22.98	24.5	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	267.38	270.16	263.16	248.28	229.49	211.83	200.03	197.26	204.25	219.13	237.92	255.58	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

Water heating gains (Table 5)

(72)m=	90.48	88.15	83.33	76.52	71.58	64.89	59.79	67.01	70.02	77.05	84.72	88.16	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	449.64	447.43	431.66	405.79	378.76	352.89	336.66	343.77	357.73	383.83	413.57	436.19	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

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Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast	0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast	0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast	0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast	0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast	0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast	0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast	0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast	0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast	0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast	0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast	0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast	0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	518.48	571.83	620.84	672	705.97	690.51	656.84	616.5	573.28	526.43	497.33	494.26	(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	1	0.99	0.97	0.9	0.77	0.82	0.96	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.5	19.62	19.85	20.18	20.52	20.81	20.94	20.91	20.69	20.26	19.83	19.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.88	19.89	19.9	19.9	19.9	19.89	19.89	19.88	19.88	(88)

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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.83	0.63	0.69	0.92	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.87	18.04	18.38	18.87	19.36	19.74	19.87	19.86	19.59	18.99	18.35	17.85	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.11	18.27	18.6	19.07	19.53	19.9	20.03	20.01	19.75	19.17	18.57	18.09	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.96	18.12	18.45	18.92	19.38	19.75	19.88	19.86	19.6	19.02	18.42	17.94	(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=	1	1	0.99	0.98	0.94	0.82	0.62	0.68	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	517.49	569.93	616.42	658.68	662.77	565.1	409.01	420.54	520.71	518.48	495.56	493.52	(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=	1850.77	1787.95	1611.43	1335.16	1021.45	676.72	430.67	453.89	726.91	1120.12	1512.69	1844.44	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.96	818.51	740.29	487.06	266.86	0	0	0	0	447.62	732.33	1005.08	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 5489.72 (98)

Space heating requirement in kWh/m²/year 51.24 (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 89.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	991.96	818.51	740.29	487.06	266.86	0	0	0	0	447.62	732.33	1005.08	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1108.34	914.53	827.14	544.21	298.17	0	0	0	0	500.13	818.25	1123	

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 6133.77 (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)

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Water heating

Output from water heater (calculated above)

	215.09	189.58	199.09	177.77	172.12	151.59	145.24	161.9	163.69	185.05	195.69	209.91	
Efficiency of water heater												89.5	(216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	240.33	211.82	222.45	198.63	192.31	169.37	162.27	180.9	182.9	206.77	218.65	234.54	

Total = Sum(219a)$_{1...12}$ = 2420.93 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6133.77	
Water heating fuel used		2420.93	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	247.21		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		277.21	(231)
Electricity for lighting		420.97	(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	=	1324.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	522.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1847.81	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	143.87	(267)
Electricity for lighting	(232) x	0.519	=	218.48	(268)
Total CO2, kg/year		sum of (265)…(271) =		2210.17	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.63	(273)
EI rating (section 14)				81	(274)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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

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

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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37	

Average = $\text{Sum}(39)_{1\ldots12}$ /12= 133.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22	

Average = $\text{Sum}(40)_{1\ldots12}$ /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 2.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 101.09 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2	

Total = $\text{Sum}(44)_{1\ldots12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7	

Total = $\text{Sum}(45)_{1\ldots12}$ = 1590.57 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (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=	50.96	46.03	50.96	48.86	48.42	44.87	46.36	48.42	48.86	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66	(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=	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66

Output from water heater (annual)$_{1\ldots12}$ | 2175.54 | (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=	67.57	59.46	62.23	55.36	53.5	46.94	44.69	50.09	50.65	57.54	61.23	65.84	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	24.25	21.53	17.51	13.26	9.91	8.37	9.04	11.75	15.77	20.03	23.38	24.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.96	274.78	267.67	252.53	233.42	215.46	203.46	200.63	207.75	222.89	242	259.96	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	90.82	88.49	83.64	76.89	71.91	65.19	60.07	67.33	70.35	77.33	85.04	88.5	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	455.27	453.05	437.07	410.92	383.49	357.26	340.82	347.96	362.12	388.5	418.66	441.62	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest	0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest	0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest	0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest	0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest	0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest	0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest	0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest	0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest	0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	513.69	561.23	608.12	661.49	699.4	686.4	651.68	607.71	560.34	514.27	490.21	490.59	(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	1	0.99	0.97	0.9	0.78	0.83	0.96	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.53	19.64	19.87	20.19	20.53	20.81	20.94	20.91	20.68	20.26	19.85	19.51	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.96	0.84	0.64	0.7	0.93	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.93	18.09	18.42	18.9	19.39	19.77	19.9	19.88	19.61	19.01	18.4	17.91	(90)

fLA = Living area ÷ (4) = 0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.15	18.31	18.62	19.09	19.55	19.92	20.04	20.03	19.76	19.19	18.6	18.14	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18	18.16	18.47	18.94	19.4	19.77	19.89	19.88	19.61	19.04	18.45	17.99	(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	1	0.99	0.98	0.94	0.83	0.63	0.69	0.92	0.99	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	512.88	559.72	604.57	650.18	660.21	567.09	411.82	422.31	514.52	507.83	488.77	489.98	(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=	1857.69	1793.7	1616.13	1339.71	1025.43	680.43	433.76	456.92	729.58	1123.95	1518.94	1852.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	1000.54	829.23	752.6	496.46	271.72	0	0	0	0	458.39	741.72	1013.66	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5564.34 (98)

Space heating requirement in kWh/m²/year 50.46 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	1000.54	829.23	752.6	496.46	271.72	0	0	0	0	458.39	741.72	1013.66	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	1117.93	926.51	840.9	554.7	303.6	0	0	0	0	512.17	828.74	1132.58	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 6217.14 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	215.87	190.26	199.79	178.61	172.93	152.3	145.92	162.67	164.46	185.69	196.38	210.66		
Efficiency of water heater													89.5	(216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	241.19	212.58	223.23	199.57	193.22	170.17	163.04	181.75	183.76	207.47	219.42	235.38		
								Total = Sum(219a)$_{1...12}$ =					2430.77	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			6217.14	
Water heating fuel used			2430.77	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		253.98		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		283.98	(231)
Electricity for lighting			428.18	(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	=	1342.9	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	525.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1867.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	147.38	(267)
Electricity for lighting	(232) x	0.519	=	222.22	(268)
Total CO2, kg/year		sum of (265)…(271) =		2237.56	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		20.29	(273)
EI rating (section 14)				81	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27754.95 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.19 (36)

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if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = Sum(39)$_{1…12}$ /12= 74.07 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01	

Average = Sum(40)$_{1…12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = Sum(44)$_{1…12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = Sum(45)$_{1…12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1...12}$ 1951.28 (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	368.48	365.87	352.49	331.29	309.81	289.03	275.88	282.24	293.38	314.79	339.31	357.81	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	413.81	449.38	483.46	521.58	548.52	537.26	510.51	479.03	444.62	411.58	394.75	395.86	(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	0.98	0.93	0.78	0.61	0.67	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.9	20.01	20.21	20.5	20.77	20.94	20.99	20.98	20.86	20.53	20.17	19.88	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.7	0.49	0.55	0.85	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.59	18.75	19.04	19.47	19.84	20.05	20.09	20.09	19.97	19.52	18.99	18.57	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.93	19.08	19.35	19.74	20.08	20.29	20.33	20.32	20.2	19.78	19.3	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.78	18.93	19.2	19.59	19.93	20.14	20.18	20.17	20.05	19.63	19.15	18.76	(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	0.97	0.89	0.71	0.51	0.56	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	412.62	447.13	477.96	503.47	488.04	380.59	257.97	269.4	374.49	400.82	392.51	394.97	(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=	1093.81	1056.68	954.03	792.13	608.54	403.63	260.77	274.36	436.47	667.5	895.45	1088.16	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	506.8	409.62	354.19	207.83	89.65	0	0	0	0	198.41	362.11	515.73		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2644.35 (98)

Space heating requirement in kWh/m²/year 35.71 (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	685.27	539.47	552.51	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.86	0.93	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	591.68	500.37	499.94	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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	82.6	128.91	102.56	0	0	0	0

Total = Sum(104)$_{6...8}$ = 314.07 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	12.41	19.36	15.41	0	0	0	0

Total = Sum(107)$_{6...8}$ = 47.18 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.64 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	506.8	409.62	354.19	207.83	89.65	0	0	0	0	198.41	362.11	515.73	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	566.26	457.67	395.74	232.22	100.17	0	0	0	0	221.68	404.59	576.24	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2954.58 (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)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72

Total = $Sum(219a)_{1...12}$ = 2180.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.63	4.1	3.26	0	0	0	0

Total = $Sum(221)_{6...8}$ = 9.98 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2954.58	
Water heating fuel used		2180.21	
Space cooling fuel used		9.98	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	158.57		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year (sum of (230a)…(230g) =)		188.57	(231)
Electricity for lighting		325.25	(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	=	638.19	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1109.11	(265)
Space cooling	(221)	x	0.519	=	5.18	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	97.87	(267)
Electricity for lighting	(232)	x	0.519	=	168.8	(268)
Total CO2, kg/year			sum of (265)…(271) =		1380.97	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		18.65	(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: 1.0.4.10

Property Address: Flat 1-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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

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

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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) = 39.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27990.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.24 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 57.66 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24

Average = Sum(39)1…12 /12= | 73.62 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98

Average = Sum(40)1…12 /12= | 0.97 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)1…12 = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)1…12 = | 1428.9 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(47) 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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Output from water heater (annual)$_{1...12}$ — 1973.65 (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)
Water heating gains (Table 5)													
(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	374.89	372.26	358.64	337.05	315.16	293.99	280.6	287.03	298.39	320.19	345.15	364.02	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.22	455.76	489.61	527.34	553.86	542.21	515.23	483.82	449.62	416.98	400.59	402.07	(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	0.98	0.93	0.78	0.6	0.66	0.9	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.94	20.05	20.24	20.52	20.78	20.95	20.99	20.98	20.87	20.55	20.2	19.92	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.9	0.7	0.49	0.55	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.67	18.82	19.11	19.52	19.88	20.08	20.12	20.12	20.01	19.57	19.06	18.65	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.99	19.14	19.4	19.78	20.11	20.3	20.34	20.34	20.23	19.82	19.35	18.97	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.84	18.99	19.25	19.63	19.96	20.15	20.19	20.19	20.08	19.67	19.2	18.82	(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	1	0.99	0.97	0.89	0.7	0.5	0.56	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.09	453.59	484.23	509.25	492.35	381.97	258.06	269.75	377.66	406.21	398.42	401.22	(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=	1090.74	1053.76	951.43	790.36	607.15	402.89	260.46	274.06	435.82	666.36	893.66	1085.65	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	499.7	403.31	347.6	202.4	85.41	0	0	0	0	193.56	356.57	509.21		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2597.76 (98)

Space heating requirement in kWh/m²/year 34.15 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.87	0.93	0.91	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	595.19	501.61	502.07	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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	85.4	133.26	106.34	0	0	0	0

Total = Sum(104)$_{6...8}$ = 325.01 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.59 (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	12.49	19.49	15.55	0	0	0	0

Total = Sum(107)$_{6...8}$ = 47.54 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.63 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	499.7	403.31	347.6	202.4	85.41	0	0	0	0	193.56	356.57	509.21		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	558.33	450.63	388.38	226.15	95.43	0	0	0	0	216.26	398.4	568.95		

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2902.53 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	
Efficiency of water heater													89.5 (216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18

Total = Sum(219a)$_{1...12}$ = 2205.19 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.64	4.13	3.29	0	0	0	0

Total = Sum(221)$_{6...8}$ = 10.06 (221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2902.53	
Water heating fuel used			2205.19	
Space cooling fuel used			10.06	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		162.85		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting			332.22	(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	=	626.95	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1103.27	(265)
Space cooling	(221) x	0.519	=	5.22	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	100.09	(267)
Electricity for lighting	(232) x	0.519	=	172.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1381	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.16	(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: 1.0.4.10

Property Address: Flat 2-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) = 37.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27828.4 (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 11.04 (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) = 48.97 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = $Sum(39)_{1…12}$ /12= 65.3 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = $Sum(40)_{1…12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1…12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1…12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1...12}$ | 1951.28 | (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	368.48	365.87	352.49	331.29	309.81	289.03	275.88	282.24	293.38	314.79	339.31	357.81	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	413.81	449.38	483.46	521.58	548.52	537.26	510.51	479.03	444.62	411.58	394.75	395.86	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.73	0.55	0.6	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.07	20.17	20.36	20.62	20.85	20.97	21	20.99	20.92	20.64	20.31	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.17	20.18	20.18	20.2	20.2	20.2	20.19	20.18	20.18	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.65	0.45	0.5	0.8	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.91	19.06	19.34	19.72	20.03	20.18	20.19	20.2	20.12	19.75	19.27	18.89	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.21	19.35	19.6	19.96	20.25	20.39	20.41	20.4	20.33	19.98	19.55	19.2	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.06	19.2	19.45	19.81	20.1	20.24	20.26	20.25	20.18	19.83	19.4	19.05	(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	0.96	0.86	0.65	0.46	0.51	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	412.63	447.02	477.28	499.41	472.37	351.36	233.51	244.7	357.49	398.68	392.37	395	(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=	985.69	952.08	859.71	712.96	547.07	361.47	234.42	246.45	392.5	601.36	806.03	979.22	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	426.36	339.4	284.53	153.76	55.58	0	0	0	0	150.8	297.83	434.67

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2142.91 (98)

Space heating requirement in kWh/m²/year 28.93 (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	602.87	474.6	485.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.92	0.97	0.95	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	555.88	458.15	462.2	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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	108.37	160.32	130.65	0	0	0	0

Total = Sum(104)$_{6...8}$ = 399.33 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	16.28	24.08	19.63	0	0	0	0

Total = Sum(107)$_{6...8}$ = 59.99 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.81 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	426.36	339.4	284.53	153.76	55.58	0	0	0	0	150.8	297.83	434.67	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	476.38	379.22	317.91	171.8	62.1	0	0	0	0	168.49	332.77	485.66	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2394.31 (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)

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Water heating

Output from water heater (calculated above)

196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72

Total = Sum(219a)$_{1...12}$ = 2180.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	3.45	5.1	4.15	0	0	0	0

Total = Sum(221)$_{6...8}$ = 12.7 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2394.31	
Water heating fuel used		2180.21	
Space cooling fuel used		12.7	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	158.57		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year — sum of (230a)…(230g) =		188.57	(231)
Electricity for lighting		325.25	(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 =	517.17	(261)
Space heating (secondary)	(215) x	0.519 =	0	(263)
Water heating	(219) x	0.216 =	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =		988.1	(265)
Space cooling	(221) x	0.519 =	6.59	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519 =	97.87	(267)
Electricity for lighting	(232) x	0.519 =	168.8	(268)
Total CO2, kg/year		sum of (265)…(271) =	1261.36	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =	17.03	(273)
EI rating (section 14)			86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	76.06	(1a)	x	2.6	(2a)	=	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			197.76	(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

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

0.15	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

* *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) = 37.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 28062.4 (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 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 48.84 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = $Sum(39)_{1...12}$ /12= 64.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = $Sum(40)_{1...12}$ /12= 0.85 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9	

Total = $Sum(44)_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47	

Total = $Sum(45)_{1...12}$ = 1428.9 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	

Output from water heater (annual)$_{1...12}$ | 1973.65 | (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	374.89	372.26	358.64	337.05	315.16	293.99	280.6	287.03	298.39	320.19	345.15	364.02	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

DER WorkSheet: New dwelling design stage

Southwest 0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest 0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest 0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest 0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest 0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest 0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest 0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest 0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest 0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.22	455.76	489.61	527.34	553.86	542.21	515.23	483.82	449.62	416.98	400.59	402.07	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.72	0.54	0.59	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.11	20.21	20.39	20.65	20.86	20.98	21	20.99	20.93	20.66	20.34	20.09	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.64	0.45	0.5	0.8	0.97	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.99	19.14	19.4	19.78	20.07	20.2	20.22	20.22	20.15	19.8	19.34	18.97	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.27	19.41	19.66	20	20.27	20.4	20.42	20.42	20.35	20.02	19.6	19.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.12	19.26	19.51	19.85	20.12	20.25	20.27	20.27	20.2	19.87	19.45	19.11	(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	0.96	0.86	0.65	0.45	0.5	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.09	453.46	483.47	504.83	475.43	351.33	232.97	244.27	359.36	403.85	398.26	401.24	(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=	981.05	947.64	855.75	710.04	544.72	360.09	233.71	245.71	391.11	599.23	802.94	975.15	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	418.09	332.09	276.97	147.75	51.56	0	0	0	0	145.37	291.37	426.99		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2090.19 (98)

Space heating requirement in kWh/m²/year 27.48 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.93	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	557.08	457.41	462.23	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	112.84	166.15	135.99	0	0	0	0

Total = Sum(104)$_{6...8}$ = 414.98 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.59 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	16.5	24.3	19.89	0	0	0	0

Total = Sum(107)$_{6...8}$ = 60.7 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.8 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	418.09	332.09	276.97	147.75	51.56	0	0	0	0	145.37	291.37	426.99	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	467.15	371.05	309.47	165.09	57.6	0	0	0	0	162.42	325.55	477.08	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2335.41 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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)

199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18

Total = Sum(219a)$_{1...12}$ = 2205.19 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	3.49	5.14	4.21	0	0	0	0

Total = Sum(221)$_{6...8}$ = 12.85 (221)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2335.41	
Water heating fuel used		2205.19	
Space cooling fuel used		12.85	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	162.85		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting		332.22	(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	=	504.45	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =				980.77	(265)
Space cooling	(221)	x	0.519	=	6.67	(266)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	100.09	(267)
Electricity for lighting	(232)	x	0.519	=	172.42	(268)
Total CO2, kg/year			sum of (265)…(271) =		1259.95	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.57	(273)
EI rating (section 14)					86	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = $Sum(39)_{1...12}$ /12= 80.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09	

Average = $Sum(40)_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	50.33	43.81	46.67	43.39	43.01	39.85	41.18	43.01	43.39	46.67	46.94	50.33	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	(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=	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18

Output from water heater (annual)$_{1...12}$ — 1951.28 (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=	61.28	53.55	55.62	49.17	47.52	41.69	39.7	44.49	44.99	51.46	55.17	59.75	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	82.37	79.68	74.76	68.29	63.87	57.9	53.35	59.8	62.48	69.16	76.62	80.3	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	368.48	365.87	352.49	331.29	309.81	289.03	275.88	282.24	293.38	314.79	339.31	357.81	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	413.81	449.38	483.46	521.58	548.52	537.26	510.51	479.03	444.62	411.58	394.75	395.86	(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	0.98	0.94	0.82	0.65	0.71	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.79	19.9	20.11	20.41	20.71	20.91	20.98	20.97	20.82	20.45	20.07	19.77	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.91	0.73	0.52	0.58	0.86	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	18.54	18.85	19.3	19.71	19.97	20.02	20.02	19.86	19.36	18.8	18.36	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.75	18.9	19.18	19.59	19.97	20.21	20.27	20.27	20.11	19.65	19.14	18.73	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.6	18.75	19.03	19.44	19.82	20.06	20.12	20.12	19.96	19.5	18.99	18.58	(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	0.97	0.9	0.74	0.53	0.59	0.86	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	412.59	447.13	478.19	505.1	495.01	396.15	272.85	283.98	382.4	401.65	392.53	394.93	(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=	1165.19	1125.71	1016.19	844.13	648.59	430.98	277.85	292.43	464.92	710.87	954.37	1160.08	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	559.94	456.01	400.27	244.1	114.26	0	0	0	0	230.06	404.52	569.27		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2978.42	(98)

Space heating requirement in kWh/m²/year | 40.22 | (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.82	0.9	0.87	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.97	523.03	519.34	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	706.39	673.64	637.8	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	70.15	112.05	88.13	0	0	0	0

Total = Sum(104)$_{6...8}$ = 270.33 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	10.54	16.83	13.24	0	0	0	0

Total = Sum(107)$_{6...8}$ = 40.61 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.55 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	559.94	456.01	400.27	244.1	114.26	0	0	0	0	230.06	404.52	569.27		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	625.63	509.51	447.23	272.74	127.66	0	0	0	0	257.04	451.98	636.06		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3327.84	(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)

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Water heating

Output from water heater (calculated above)

	196.8	171.91	178.86	158.64	153.59	135.27	129.6	144.48	146.07	166.33	177.56	192.18	
Efficiency of water heater													89.5 (216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	219.89	192.08	199.84	177.25	171.61	151.14	144.81	161.43	163.21	185.85	198.39	214.72

Total = $Sum(219a)_{1...12}$ = 2180.21 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.23	3.56	2.8	0	0	0	0

Total = $Sum(221)_{6...8}$ = 8.59 (221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3327.84	
Water heating fuel used			2180.21	
Space cooling fuel used			8.59	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		158.57		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		188.57	(231)
Electricity for lighting			325.25	(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	=	718.81	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	470.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1189.74	(265)
Space cooling	(221) x	0.519	=	4.46	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	97.87	(267)
Electricity for lighting	(232) x	0.519	=	168.8	(268)
Total CO2, kg/year		sum of (265)…(271) =		1460.87	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.73	(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: 1.0.4.10

Property Address: Flat 3-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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

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

0.15	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26201.45 (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 | 23.27 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss | (33) + (36) = | 64.17 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K | (39)m = (37) + (38)m

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75	

Average = Sum(39)$_{1\ldots12}$ /12= | 80.13 | (39)

Heat loss parameter (HLP), W/m²K | (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06	

Average = Sum(40)$_{1\ldots12}$ /12= | 1.05 | (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 | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9	

Total = Sum(44)$_{1\ldots12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47	

Total = Sum(45)$_{1\ldots12}$ = | 1428.9 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	50.91	44.31	47.2	43.89	43.5	40.31	41.65	43.5	43.89	47.2	47.47	50.91	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	(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=	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38	

Output from water heater (annual)$_{1...12}$ | 1973.65 | (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=	61.99	54.16	56.26	49.73	48.07	42.17	40.15	45	45.5	52.04	55.8	60.43	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	83.31	80.59	75.62	69.07	64.6	58.57	53.97	60.48	63.2	69.95	77.5	81.22	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	374.89	372.26	358.64	337.05	315.16	293.99	280.6	287.03	298.39	320.19	345.15	364.02	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

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Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	420.22	455.76	489.61	527.34	553.86	542.21	515.23	483.82	449.62	416.98	400.59	402.07	(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	0.98	0.94	0.81	0.65	0.7	0.91	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.82	19.93	20.14	20.43	20.72	20.92	20.98	20.97	20.83	20.47	20.1	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.91	0.73	0.52	0.58	0.86	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.44	18.6	18.91	19.34	19.74	19.99	20.04	20.04	19.89	19.4	18.86	18.42	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	18.94	19.22	19.62	19.99	20.23	20.28	20.28	20.13	19.68	19.17	18.77	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.64	18.79	19.07	19.47	19.84	20.08	20.13	20.13	19.98	19.53	19.02	18.62	(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	1	0.99	0.97	0.9	0.74	0.53	0.59	0.86	0.98	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.06	453.6	484.5	511.13	500.36	399.6	274.65	286.07	386.78	407.18	398.45	401.19	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1169.2	1129.63	1019.75	847.5	651.18	432.98	279.26	293.96	467.13	714.04	958.41	1164.68	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	558.1	454.29	398.23	242.19	112.21	0	0	0	0	228.31	403.17	568.04		
Total per year (kWh/year) = Sum(98)1...5,9...12 =													2964.54	(98)

Space heating requirement in kWh/m²/year 38.98 (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	743.01	584.92	599.29	0	0	0	0		(100)
Utilisation factor for loss hm														
(101)m=	0	0	0	0	0	0.83	0.9	0.87	0	0	0	0		(101)
Useful loss, hmLm (Watts) = (100)m x (101)m														
(102)m=	0	0	0	0	0	614.95	527.28	524.16	0	0	0	0		(102)
Gains (solar gains calculated for applicable weather region, see Table 10)														
(103)m=	0	0	0	0	0	713.8	680.73	645.01	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	71.18	114.17	89.91	0	0	0	0		
Total = Sum(104)6...8 =													275.25	(104)
Cooled fraction — f C = cooled area ÷ (4) =													0.59	(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	10.41	16.7	13.15	0	0	0	0		
Total = Sum(107)6...8 =													40.26	(107)
Space cooling requirement in kWh/m²/year — (107) ÷ (4) =													0.53	(108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	558.1	454.29	398.23	242.19	112.21	0	0	0	0	228.31	403.17	568.04		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	623.58	507.58	444.95	270.61	125.38	0	0	0	0	255.09	450.47	634.68		
Total (kWh/year) =Sum(211)1...5,10...12=													3312.34	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	199.05	173.88	180.91	160.46	155.35	136.82	131.09	146.13	147.75	168.24	179.59	194.38		
Efficiency of water heater													89.5	(216)
(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	222.41	194.28	202.13	179.28	173.58	152.88	146.47	163.28	165.08	187.98	200.66	217.18		
								Total = Sum(219a)$_{1...12}$ =					2205.19	(219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	2.2	3.53	2.78	0	0	0	0		
								Total = Sum(221)$_{6...8}$ =					8.52	(221)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3312.34	
Water heating fuel used			2205.19	
Space cooling fuel used			8.52	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		162.85		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		192.85	(231)
Electricity for lighting			332.22	(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	=	715.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	476.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1191.79	(265)
Space cooling	(221) x	0.519	=	4.42	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	100.09	(267)
Electricity for lighting	(232) x	0.519	=	172.42	(268)
Total CO2, kg/year		sum of (265)…(271) =		1468.72	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		19.31	(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: 1.0.4.10

Property Address: Flat 4-1-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	54.34	(1a) x	2.6	(2a) =	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	141.28	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 69.69 (37)

DER WorkSheet: New dwelling design stage

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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = Sum(39)$_{1…12}$ /12= 81.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51	

Average = Sum(40)$_{1…12}$ /12= 1.5 (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 1.82 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12	

Total = Sum(44)$_{1…12}$ = 928.53 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24	

Total = Sum(45)$_{1…12}$ = 1217.45 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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=	43.37	37.75	40.22	37.4	37.06	34.34	35.49	37.06	37.4	40.22	40.45	43.37	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61	(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=	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61

Output from water heater (annual)$_{1\ldots12}$ — 1681.59 (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=	52.81	46.14	47.93	42.37	40.95	35.93	34.21	38.34	38.77	44.34	47.54	51.49	(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=	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.13	12.55	10.21	7.73	5.78	4.88	5.27	6.85	9.19	11.67	13.62	14.52	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	158.48	160.13	155.98	147.16	136.02	125.56	118.56	116.92	121.06	129.89	141.02	151.49	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)

Water heating gains (Table 5)

(72)m=	70.98	68.67	64.43	58.85	55.04	49.9	45.98	51.53	53.85	59.6	66.03	69.2	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	296.87	294.61	283.88	267.01	250.11	233.6	223.08	228.57	237.37	254.43	273.94	288.49	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast 0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest 0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest 0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest 0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest 0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest 0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest 0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest 0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest 0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest 0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest 0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest 0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest 0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest 0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest 0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest 0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest 0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest 0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest 0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest 0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest 0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest 0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest 0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest 0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest 0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	328.25	354.3	382.13	416.51	442.93	436.18	413.74	385.22	353.1	324.87	312.66	314.61	(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

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(86)m=	1	1	0.99	0.98	0.95	0.87	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.29	19.42	19.68	20.06	20.45	20.77	20.92	20.89	20.63	20.14	19.66	19.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.92	0.78	0.57	0.64	0.89	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.43	17.62	18	18.55	19.11	19.53	19.66	19.65	19.36	18.68	17.97	17.4	(90)

fLA = Living area ÷ (4) = 0.25 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.9	18.07	18.42	18.93	19.45	19.84	19.98	19.96	19.68	19.05	18.39	17.87	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.75	17.92	18.27	18.78	19.3	19.69	19.83	19.81	19.53	18.9	18.24	17.72	(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	0.99	0.97	0.91	0.78	0.59	0.65	0.88	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	326.57	351.63	376.76	402.47	403.73	340.22	244.91	251.11	311.23	316.23	310.03	313.26	(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=	1112.66	1075.06	970.08	807.3	619.43	411.21	260.89	275	440.25	676.65	912.25	1110.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	584.85	486.15	441.43	291.48	160.48	0	0	0	0	268.16	433.6	593.32	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3259.46 (98)

Space heating requirement in kWh/m²/year 59.98 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.68	0.76	0.72	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	513.49	456.79	444.35	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	570.35	543.05	510.34	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	0	64.18	49.1	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 113.27 (104)

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Cooled fraction f C = cooled area ÷ (4) = 0.7 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	11.22	8.58	0	0	0	0

Total = Sum(107) = 19.8 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.36 (108)

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 89.5 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

Cooling System Energy Efficiency Ratio 4.73 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	584.85	486.15	441.43	291.48	160.48	0	0	0	0	268.16	433.6	593.32	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	653.46	543.18	493.22	325.68	179.3	0	0	0	0	299.62	484.46	662.93	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3641.85 (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)

	169.6	148.15	154.14	136.71	132.36	116.58	111.69	124.51	125.88	143.34	153.02	165.61

Efficiency of water heater 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	189.49	165.53	172.22	152.75	147.89	130.25	124.79	139.11	140.65	160.16	170.97	185.04

Total = Sum(219a)$_{1...12}$ = 1878.87 (219)

Space cooling fuel, kWh/month.

(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	0	2.37	1.82	0	0	0	0

Total = Sum(221)$_{6...8}$ = 4.19 (221)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3641.85
Water heating fuel used		1878.87
Space cooling fuel used		4.19

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Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	90.49		(230a)
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	120.49	(231)
Electricity for lighting		249.52	(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	=	786.64	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	405.84	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1192.47	(265)
Space cooling	(221) x	0.519	=	2.18	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	62.54	(267)
Electricity for lighting	(232) x	0.519	=	129.5	(268)
Total CO2, kg/year		sum of (265)…(271) =		1386.69	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		25.52	(273)
EI rating (section 14)				81	(274)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Lean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		144.59	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (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) =	69.75	(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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87	

Average = $Sum(39)_{1...12}$ /12= 81.42 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09	

Total = $Sum(44)_{1...12}$ = 939.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64	

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	43.87	38.18	40.68	37.82	37.49	34.74	35.89	37.49	37.82	40.68	40.91	43.87	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51	(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=	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51

Output from water heater (annual)$_{1...12}$ 1700.79 (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=	53.42	46.67	48.48	42.86	41.42	36.34	34.6	38.78	39.21	44.85	48.08	52.08	(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=	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.42	12.81	10.42	7.89	5.89	4.98	5.38	6.99	9.38	11.91	13.9	14.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	161.76	163.43	159.2	150.2	138.83	128.15	121.01	119.33	123.56	132.57	143.94	154.62	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	71.8	69.45	65.16	59.52	55.67	50.47	46.51	52.12	54.46	60.28	66.78	70	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	301.8	299.52	288.61	271.44	254.23	237.43	226.72	232.27	241.24	258.59	278.45	293.26	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast 0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast 0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast 0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast 0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast 0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast 0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast 0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast 0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast 0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast 0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast 0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest 0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest 0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest 0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest 0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest 0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest 0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest 0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest 0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest 0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest 0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest 0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest 0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest 0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest 0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest 0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest 0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest 0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest 0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest 0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest 0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest 0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest 0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest 0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest 0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	333.18	359.21	386.85	420.94	447.04	440	417.38	388.92	356.96	329.03	317.17	319.38	(84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.87	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.34	19.46	19.71	20.09	20.47	20.78	20.92	20.9	20.64	20.17	19.69	19.31	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.78	0.57	0.64	0.89	0.98	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.51	17.69	18.07	18.61	19.16	19.56	19.69	19.68	19.4	18.74	18.04	17.49	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.98	18.15	18.49	18.99	19.49	19.88	20.01	19.99	19.72	19.1	18.47	17.95	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.83	18	18.34	18.84	19.34	19.73	19.86	19.84	19.57	18.95	18.32	17.8	(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	0.97	0.91	0.78	0.59	0.65	0.88	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	331.57	356.64	381.65	407.18	408.16	343.76	247.44	253.86	315.11	320.55	314.62	318.09	(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=	1115.35	1077.7	972.55	809.74	621.54	413.22	262.82	276.99	442.45	679.24	915.17	1113.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	583.13	484.55	439.63	289.84	158.76	0	0	0	0	266.87	432.39	592.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3247.18 | (98)

Space heating requirement in kWh/m²/year | 58.39 | (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.68	0.77	0.73	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	518.44	460.63	448.62	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	576.05	548.51	515.89	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	0	65.38	50.05	0	0	0	0

Total = $Sum(104)_{6..8}$ = 115.43 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.68 (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	0	11.17	8.55	0	0	0	0

Total = $Sum(107)_{6..8}$ = 19.72 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.35 (108)

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		89.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)
Cooling System Energy Efficiency Ratio		4.73	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	583.13	484.55	439.63	289.84	158.76	0	0	0	0	266.87	432.39	592.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	651.54	541.4	491.21	323.85	177.38	0	0	0	0	298.18	483.12	661.46	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 3628.14 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$Sum(215)_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

	171.53	149.84	155.9	138.27	133.87	117.91	112.97	125.93	127.32	144.98	154.76	167.51

Efficiency of water heater — 89.5 (216)

(217)m=	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	89.5	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	191.66	167.42	174.19	154.5	149.58	131.74	126.22	140.7	142.26	161.99	172.92	187.16

Total = $Sum(219a)_{1..12}$ = 1900.33 (219)

Space cooling fuel, kWh/month.
(221)m = (107)m÷ (209)

(221)m=	0	0	0	0	0	0	2.36	1.81	0	0	0	0

Total = $Sum(221)_{6..8}$ = 4.17 (221)

DER WorkSheet: New dwelling design stage

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3628.14	
Water heating fuel used			1900.33	
Space cooling fuel used			4.17	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		92.61		(230a)
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		122.61	(231)
Electricity for lighting			254.67	(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	=	783.68	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	410.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1194.15	(265)
Space cooling	(221) x	0.519	=	2.17	(266)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	63.63	(267)
Electricity for lighting	(232) x	0.519	=	132.18	(268)
Total CO2, kg/year		sum of (265)…(271) =		1392.12	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		25.03	(273)
EI rating (section 14)				81	(274)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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

DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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		36.66	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	107.78	(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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = Sum(39)$_{1…12}$ /12= 133.24 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = Sum(40)$_{1…12}$ /12= 1.24 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68	

Total = Sum(44)$_{1…12}$ = 1207.41 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96	

Total = Sum(45)$_{1…12}$ = 1583.1 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(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)

DER WorkSheet: New dwelling design stage

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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23	(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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23

Output from water heater (annual)$_{1...12}$ | 2233.94 | (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=	98.8	87.67	93.48	85.74	85.42	78.35	77.17	82.03	81.05	88.81	91.47	97.07	(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=	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	23.84	21.17	17.22	13.04	9.74	8.23	8.89	11.55	15.51	19.69	22.98	24.5	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	267.38	270.16	263.16	248.28	229.49	211.83	200.03	197.26	204.25	219.13	237.92	255.58	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(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=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

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Water heating gains (Table 5)

(72)m=	132.79	130.47	125.64	119.08	114.82	108.82	103.72	110.25	112.57	119.37	127.03	130.48	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	488.96	486.74	470.97	445.34	419	393.82	377.59	384.01	397.28	423.14	452.89	475.51	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast	0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast	0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast	0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast	0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast	0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast	0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast	0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast	0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast	0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast	0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast	0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast	0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast	0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast	0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast	0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast	0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast	0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast	0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast	0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast	0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast	0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast	0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast	0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast	0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast	0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast	0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast	0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast	0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast	0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast	0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast	0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast	0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast	0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast	0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast	0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast	0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast	0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast	0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast	0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast	0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast	0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast	0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast	0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	557.8	611.15	660.16	711.56	746.21	731.44	697.78	656.74	612.84	565.75	536.64	533.58	(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	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.65	19.88	20.22	20.55	20.83	20.95	20.93	20.71	20.29	19.86	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.88	19.89	19.9	19.9	19.9	19.89	19.89	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.81	0.6	0.66	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.09	18.43	18.92	19.4	19.76	19.88	19.87	19.63	19.03	18.4	17.9	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.15	18.32	18.64	19.11	19.57	19.92	20.03	20.02	19.79	19.22	18.62	18.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.15	18.32	18.64	19.11	19.57	19.92	20.03	20.02	19.79	19.22	18.62	18.13	(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	1	0.99	0.98	0.93	0.81	0.62	0.67	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	556.42	608.62	654.5	695.26	695.66	590.73	429.55	441.82	550.66	555.4	534.2	532.52	(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=	1877.45	1814.53	1637.87	1361.03	1046.38	699.12	451.17	474.71	750.9	1146	1538.97	1870.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	982.84	810.37	731.62	479.36	260.93	0	0	0	0	439.41	723.43	995.74	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5423.71 (98)

Space heating requirement in kWh/m²/year 50.62 (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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		5423.71	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	740.34	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4954.56	(307b)
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		2233.94	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	304.93	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2040.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	80.41	(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		247.21	(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) =	247.21	(331)
Energy for lighting (calculated in Appendix L)		420.97	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1175.14	x	0.22		253.83	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	359.59	x	0.52		-186.63	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	484.02	x	0.22		104.55	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.11	x	0.52		-76.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1562.54	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	41.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1699.15	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1699.15	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	128.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	218.48	(379)
Total CO2, kg/year	sum of (376)…(382) =					2045.94	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					19.1	(384)

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EI rating (section 14)	81.98	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37	

Average = Sum(39)$_{1…12}$ /12= 133.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	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 2.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 101.09 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2	

Total = Sum(44)$_{1…12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7	

Total = Sum(45)$_{1…12}$ = 1590.57 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98	(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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98

Output from water heater (annual)$_{1...12}$ — 2241.41 — (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=	99.05	87.9	93.71	85.94	85.62	78.52	77.32	82.21	81.23	89.02	91.69	97.32	(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=	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	24.25	21.53	17.51	13.26	9.91	8.37	9.04	11.75	15.77	20.03	23.38	24.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.96	274.78	267.67	252.53	233.42	215.46	203.46	200.63	207.75	222.89	242	259.96	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	(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=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	133.14	130.8	125.95	119.36	115.08	109.05	103.93	110.49	112.83	119.65	127.35	130.81	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	494.59	492.36	476.38	450.39	423.65	398.12	381.67	388.13	401.59	427.81	457.97	480.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast	0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast	0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast	0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast	0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest	0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest	0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest	0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest	0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest	0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest	0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest	0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest	0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest	0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest	0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest	0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest	0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest	0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest	0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest	0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest	0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest	0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest	0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest	0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest	0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest	0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest	0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest	0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest	0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	553	600.54	647.44	700.96	739.56	727.25	692.54	647.87	599.81	553.58	529.52	529.9	(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	1	0.99	0.96	0.88	0.75	0.8	0.95	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.67	19.9	20.22	20.56	20.83	20.95	20.93	20.71	20.3	19.88	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.81	0.61	0.67	0.91	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.98	18.14	18.47	18.95	19.43	19.79	19.9	19.89	19.65	19.06	18.45	17.96	(90)

fLA = Living area ÷ (4) = 0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.2	18.36	18.67	19.13	19.59	19.94	20.05	20.04	19.8	19.23	18.65	18.18	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.2	18.36	18.67	19.13	19.59	19.94	20.05	20.04	19.8	19.23	18.65	18.18	(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	1	0.99	0.98	0.94	0.82	0.62	0.69	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	551.87	598.52	642.85	687.01	693.46	592.99	432.47	443.82	545.07	545.07	527.51	529.03	(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=	1884.25	1820.18	1642.49	1365.54	1050.37	702.89	454.31	477.83	753.68	1149.8	1545.14	1878.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.29	820.95	743.73	488.54	265.54	0	0	0	0	449.92	732.69	1004.21	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 5496.88 (98)

Space heating requirement in kWh/m²/year 49.84 (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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		5496.88	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	750.32	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	5021.4	(307b)
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		2241.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	305.95	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2047.53	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	81.25	(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		253.98	(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) =	253.98	(331)
Energy for lighting (calculated in Appendix L)		428.18	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1190.99	x	0.22	257.25	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	364.44	x	0.52	-189.15	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	0.22	104.9	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	0.52	-77.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22 =	1578.99	(368)
Electrical energy for heat distribution	[(313) x			0.52 =	42.17	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1717.04	(373)
CO2 associated with space heating (secondary)	(309) x			0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1717.04	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52 =	131.81	(378)
CO2 associated with electricity for lighting	(332))) x			0.52 =	222.22	(379)
Total CO2, kg/year	sum of (376)…(382) =				2071.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.78	(384)

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EI rating (section 14)	82.13	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) = 39.55 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27754.95 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 18.19 (36)

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if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = $Sum(39)_{1...12}$ /12= 74.07 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01

Average = $Sum(40)_{1...12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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
(44)m=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ — 2063.55 (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

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Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.75	0.57	0.62	0.87	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.06	20.26	20.54	20.8	20.96	20.99	20.99	20.89	20.57	20.22	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.87	0.66	0.46	0.51	0.8	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=	18.66	18.82	19.12	19.53	19.88	20.06	20.09	20.09	20	19.58	19.06	18.64	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19	19.15	19.42	19.8	20.12	20.3	20.33	20.33	20.23	19.84	19.37	18.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19	19.15	19.42	19.8	20.12	20.3	20.33	20.33	20.23	19.84	19.37	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=	1	0.99	0.98	0.96	0.87	0.68	0.49	0.54	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.45	486.09	516.24	538.32	514.26	395.73	269.42	281.3	396.19	436.36	431.29	433.93	(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=	1110.28	1073.13	970.35	807.72	622.56	415.42	271.85	285.52	449.57	683.17	911.67	1104.48	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	490.17	394.49	337.86	193.97	80.58	0	0	0	0	183.63	345.87	498.89

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2525.45 (98)

Space heating requirement in kWh/m²/year 34.1 (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	685.27	539.47	552.51	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.06	508.87	511.09	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	103.63	156.51	127.74	0	0	0	0	

Total = Sum(104)6...8 = 387.89 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	15.57	23.51	19.19	0	0	0	0

Total = Sum(107)6...8 = 58.27 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.79 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2525.45	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	344.72	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2307	(307b)
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		2063.55	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	48.18	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.33	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	547.18	x	0.22		118.19	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	167.44	x	0.52		-86.9	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	936.38	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	25.01	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1018.25	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1018.25	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.4	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1275.75	(383)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate	(383) ÷ (4) =	17.23	(384)
EI rating (section 14)		85.64	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) = 39.42 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27990.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.24 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 57.66 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24	

Average = $Sum(39)_{1…12}$ /12= | 73.62 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98

Average = $Sum(40)_{1…12}$ /12= | 0.97 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1…12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1…12}$ = | 1428.9 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

DER WorkSheet: New dwelling design stage

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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.62	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.99	20.1	20.29	20.57	20.82	20.96	20.99	20.99	20.9	20.6	20.25	19.97	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.66	0.46	0.51	0.8	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=	18.74	18.9	19.18	19.59	19.92	20.09	20.12	20.12	20.03	19.63	19.13	18.72	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.06	19.2	19.47	19.84	20.15	20.32	20.34	20.34	20.25	19.88	19.42	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.06	19.2	19.47	19.84	20.15	20.32	20.34	20.34	20.25	19.88	19.42	19.04	(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	0.96	0.87	0.68	0.48	0.54	0.81	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.75	492.4	522.36	543.92	518.18	396.76	269.39	281.48	398.9	441.56	437.05	440.01	(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=	1106.97	1069.98	967.54	805.76	620.97	414.55	271.47	285.14	448.72	681.83	909.67	1101.74	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	483.02	388.13	331.21	188.52	76.47	0	0	0	0	178.77	340.28	492.33

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2478.73 (98)

Space heating requirement in kWh/m²/year 32.59 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	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	610.8	509.45	512.46	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	106.88	161.24	131.96	0	0	0	0

Total = Sum(104)$_{6...8}$ = 400.08 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.59 (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	15.63	23.58	19.3	0	0	0	0

Total = Sum(107)$_{6...8}$ = 58.52 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.77 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2478.73	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	338.35	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2264.32	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.86	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.38	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	537.06	x	0.22		116	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	164.34	x	0.52		-85.29	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	930.15	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.84	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1011.48	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1011.48	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.43	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1274.85	(383)

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Dwelling CO2 Emission Rate	(383) ÷ (4) =	16.76	(384)
EI rating (section 14)		85.89	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) = 37.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27828.4 (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 11.04 (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) =	48.97	(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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = $Sum(39)_{1...12}$ /12= 65.3 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = $Sum(40)_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(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	0.68	0.51	0.56	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=	20.12	20.22	20.41	20.67	20.88	20.98	21	21	20.94	20.68	20.36	20.1	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.17	20.18	20.18	20.2	20.2	20.2	20.19	20.18	20.18	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.83	0.61	0.42	0.46	0.76	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=	18.98	19.14	19.41	19.79	20.07	20.18	20.2	20.2	20.14	19.81	19.35	18.97	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.42	19.67	20.02	20.28	20.39	20.41	20.41	20.35	20.04	19.62	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.42	19.67	20.02	20.28	20.39	20.41	20.41	20.35	20.04	19.62	19.27	(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	0.95	0.84	0.63	0.44	0.49	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.4	485.81	515.02	532.37	494.54	363.28	243.33	254.71	375.02	432.78	430.93	433.91	(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=	1000.34	966.7	874.16	726.52	558.89	371.5	244.09	256.14	403.5	615.07	820.41	993.72	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	408.42	323.16	267.2	139.79	47.88	0	0	0	0	135.63	280.42	416.5	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2018.99 (98)

Space heating requirement in kWh/m²/year 27.26 (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	602.87	474.6	485.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.25	462.49	468.37	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	133.74	191.02	159.52	0	0	0	0	

Total = Sum(104)6...8 = 484.28 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (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	20.09	28.69	23.96	0	0	0	0	

Total = Sum(107)6...8 = 72.75 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.98 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2018.99	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	275.59	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1844.35	(307b)
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		2063.55	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.87	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.4	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	437.45	x	0.22		94.49	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	133.86	x	0.52		-69.47	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	833.04	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.25	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	905.87	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					905.87	(376)
CO2 associated with space cooling	(315) x			0.52	=	7.99	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1164.96	(383)

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Dwelling CO2 Emission Rate	(383) ÷ (4) =	15.73	(384)
EI rating (section 14)		86.89	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	197.76	(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) =	76.5	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) =	37.84	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	28062.4	(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	(36)

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if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 48.84 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = $Sum(39)_{1...12}$ /12= 64.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = $Sum(40)_{1...12}$ /12= 0.85 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = 1428.9 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m^2		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(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	0.68	0.5	0.55	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=	20.16	20.26	20.44	20.69	20.89	20.98	21	21	20.95	20.7	20.39	20.14	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.83	0.6	0.41	0.46	0.75	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=	19.06	19.21	19.47	19.84	20.1	20.21	20.22	20.22	20.17	19.86	19.41	19.04	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.34	19.48	19.72	20.05	20.3	20.41	20.42	20.42	20.37	20.08	19.66	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.34	19.48	19.72	20.05	20.3	20.41	20.42	20.42	20.37	20.08	19.66	19.32	(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	0.95	0.83	0.62	0.44	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.68	492.09	521.03	537.49	497.01	362.92	242.69	254.15	376.3	437.65	436.65	439.98	(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=	995.46	962.03	869.97	723.39	556.33	370.01	243.3	255.32	401.92	612.72	817.11	989.42	(97)

DER WorkSheet: New dwelling design stage

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	400.11	315.8	259.61	133.85	44.13	0	0	0	0	130.25	273.93	408.79

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1966.47 (98)

Space heating requirement in kWh/m²/year 25.85 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.98	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.6	461.21	467.74	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	138.71	197.13	165.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 501.07 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	20.29	28.83	24.17	0	0	0	0

Total = Sum(107)$_{6...8}$ = 73.29 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.96 (108)

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 CHP 0.13 (303a)

Fraction of community heat from heat source 2 0.87 (303b)

Fraction of total space heat from Community CHP (302) x (303a) = 0.13 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.87 (304b)

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)

Space heating **kWh/year**

Annual space heating requirement 1966.47

Space heat from Community CHP (98) x (304a) x (305) x (306) = 268.42 (307a)

DER WorkSheet: New dwelling design stage

Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1796.37	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.49	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.51	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	426.07	x	0.22		92.03	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	130.38	x	0.52		-67.67	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	825.63	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.05	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	897.81	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					897.81	(376)
CO2 associated with space cooling	(315) x			0.52	=	8.05	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1162.8	(383)

DER WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate	(383) ÷ (4) =	15.29	(384)
EI rating (section 14)		87.13	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	74.06	(1a)	x	2.6	(2a)	=	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	192.56	(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

			Value	
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

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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

DER WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = Sum(39)$_{1...12}$ /12= 80.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09

Average = Sum(40)$_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77

Total = Sum(44)$_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85

Total = Sum(45)$_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)1…12 | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(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	0.98	0.92	0.78	0.61	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.84	19.95	20.16	20.46	20.74	20.93	20.99	20.98	20.85	20.5	20.12	19.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.54	0.83	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=	18.45	18.61	18.92	19.36	19.75	19.98	20.02	20.02	19.9	19.43	18.88	18.43	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.81	18.96	19.25	19.65	20.01	20.23	20.28	20.27	20.15	19.71	19.2	18.79	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.81	18.96	19.25	19.65	20.01	20.23	20.28	20.27	20.15	19.71	19.2	18.79	(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	0.96	0.89	0.71	0.52	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.43	486.15	516.68	540.75	523.21	413.46	285.5	297.27	406.34	437.8	431.39	433.9	(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=	1182.88	1143.39	1033.77	861.04	664.04	444.04	289.93	304.65	479.42	727.84	971.82	1177.62	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	544.2	441.67	384.71	230.61	104.78	0	0	0	0	215.79	389.11	553.33

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2864.18 (98)

Space heating requirement in kWh/m²/year 38.67 (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	628.97	534.61	533.86	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	88.58	137.36	110.8	0	0	0	0

Total = Sum(104)$_{6...8}$ = 336.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	13.31	20.63	16.64	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.68 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2864.18	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	390.96	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2616.43	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.74	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.71	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	620.57	x	0.22		134.04	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	189.9	x	0.52		-98.56	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1005.5	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	26.85	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1093.41	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1093.41	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.56	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	168.8	(379)
Total CO2, kg/year	sum of (376)…(382) =					1350.07	(383)

Dwelling CO2 Emission Rate	(383) ÷ (4) =	18.23	(384)
EI rating (section 14)		84.81	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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

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

0.15	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26201.45 (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 — 23.27 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss — (33) + (36) = 64.17 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K — (39)m = (37) + (38)m

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75

Average = Sum(39)$_{1…12}$ /12= 80.13 (39)

Heat loss parameter (HLP), W/m²K — (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06

Average = Sum(40)$_{1…12}$ /12= 1.05 (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 — 2.38 (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 — 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	

Output from water heater (annual)$_{1...12}$ — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39		0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85		0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85		0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27		0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27		0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07		0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07		0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49		0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49		0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(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	0.98	0.92	0.78	0.6	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	19.98	20.18	20.48	20.75	20.94	20.99	20.98	20.86	20.52	20.15	19.85	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.54	0.83	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=	18.51	18.67	18.98	19.41	19.79	20	20.05	20.04	19.93	19.47	18.93	18.49	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.86	19.01	19.28	19.68	20.03	20.24	20.29	20.28	20.16	19.74	19.24	18.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.86	19.01	19.28	19.68	20.03	20.24	20.29	20.28	20.16	19.74	19.24	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	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.71	0.52	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.74	492.49	522.88	546.7	528.43	416.75	287.26	299.3	410.53	443.22	437.18	439.99	(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=	1186.76	1147.19	1037.22	864.33	666.56	446.01	291.35	306.17	481.57	730.92	975.76	1182.11	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	542.39	439.96	382.66	228.69	102.77	0	0	0	0	214.05	387.78	552.14

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2850.45 (98)

Space heating requirement in kWh/m²/year 37.48 (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	743.01	584.92	599.29	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	634.58	538.46	538.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	89.76	139.66	112.76	0	0	0	0	

Total = Sum(104)$_{6..8}$ = 342.18 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	13.13	20.43	16.49	0	0	0	0

Total = Sum(107)$_{6..8}$ = 50.05 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.66 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2850.45	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	389.09	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2603.88	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.77	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.59	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	617.6	x	0.22		133.4	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	188.98	x	0.52		-98.08	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1006	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	26.87	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1093.96	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1093.96	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.5	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	172.42	(379)
Total CO2, kg/year	sum of (376)…(382) =					1356.4	(383)

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Dwelling CO2 Emission Rate	(383) ÷ (4) =	17.83	(384)
EI rating (section 14)		84.99	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	54.34	(1a) x	2.6	(2a) =	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		141.28	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 69.69 (37)

DER WorkSheet: New dwelling design stage

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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = Sum(39)$_{1...12}$ /12= 81.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51	

Average = Sum(40)$_{1...12}$ /12= 1.5 (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 1.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12	

Total = Sum(44)$_{1...12}$ = 928.53 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24	

Total = Sum(45)$_{1...12}$ = 1217.45 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52

Output from water heater (annual)$_{1…12}$ — 1868.29 (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=	86.19	76.65	82.1	75.82	75.91	70.14	69.56	73.3	72.22	78.51	80.22	84.87	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.13	12.55	10.21	7.73	5.78	4.88	5.27	6.85	9.19	11.67	13.62	14.52	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	158.48	160.13	155.98	147.16	136.02	125.56	118.56	116.92	121.06	129.89	141.02	151.49	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	(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=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)

Water heating gains (Table 5)

(72)m=	115.85	114.06	110.35	105.3	102.03	97.41	93.49	98.52	100.3	105.52	111.42	114.07	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	338.73	337.01	326.81	310.46	294.1	278.12	267.6	272.55	280.83	297.35	316.34	330.35	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Northeast	0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	370.11	396.7	425.05	459.97	486.91	480.69	458.26	429.2	396.55	367.79	355.06	356.47	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

(86)m=	1	0.99	0.99	0.98	0.93	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.36	19.49	19.75	20.12	20.51	20.81	20.94	20.91	20.68	20.21	19.73	19.34	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.9	0.74	0.52	0.58	0.85	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=	17.53	17.71	18.09	18.64	19.18	19.56	19.67	19.66	19.42	18.77	18.07	17.5	(90)

fLA = Living area ÷ (4) = 0.25 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.99	18.16	18.51	19.01	19.51	19.87	19.99	19.98	19.73	19.13	18.48	17.96	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.99	18.16	18.51	19.01	19.51	19.87	19.99	19.98	19.73	19.13	18.48	17.96	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.75	0.57	0.62	0.86	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	367.38	392.51	417.04	440.27	435.54	362.05	259.6	267.23	339.64	354.44	350.71	354.22	(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=	1132.5	1094.9	989.8	826.4	637.1	426.11	273.9	288.39	456.98	695.8	931.89	1130.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	569.24	472	426.14	278.01	149.96	0	0	0	0	253.97	418.45	577.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3145.31 (98)

Space heating requirement in kWh/m²/year 57.88 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.71	0.8	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	542.27	478.02	468.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	617.86	590.56	557.32	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	0	83.73	65.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 149.67 (104)

DER WorkSheet: New dwelling design stage

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(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) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.64	11.53	0	0	0	0

	Total = Sum(107) =	26.17	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.48	(108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		3145.31	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	429.33	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2873.24	(307b)
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		1868.29	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	255.02	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1706.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	52.64	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.54	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		90.49	(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) =	90.49	(331)

Energy for lighting (calculated in Appendix L)						249.52	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	681.48	x	0.22		147.2	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	208.53	x	0.52		-108.23	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	0.22		87.44	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	0.52		-64.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1023.02	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	27.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1112.46	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1112.46	(376)
CO2 associated with space cooling	(315) x			0.52	=	2.87	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	46.97	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	129.5	(379)
Total CO2, kg/year	sum of (376)…(382) =					1291.8	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					23.77	(384)
EI rating (section 14)						82.57	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Clean

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.59	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss (33) + (36) = 69.75 (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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87	

Average = $Sum(39)_{1...12}$ /12= 81.42 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 1.86 (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 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09

Total = $Sum(44)_{1...12}$ = 939.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64

Total = $Sum(45)_{1...12}$ = 1231.35 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91

Output from water heater (annual)$_{1...12}$ — 1882.19 (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=	86.67	77.07	82.53	76.2	76.27	70.45	69.85	73.63	72.55	78.9	80.65	85.33	(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=	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.42	12.81	10.42	7.89	5.89	4.98	5.38	6.99	9.38	11.91	13.9	14.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	161.76	163.43	159.2	150.2	138.83	128.15	121.01	119.33	123.56	132.57	143.94	154.62	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	116.49	114.68	110.93	105.83	102.51	97.85	93.88	98.96	100.77	106.05	112.02	114.69	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	343.5	341.76	331.38	314.74	298.07	281.8	271.1	276.11	284.54	301.36	320.68	334.96	(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	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	374.88	401.44	429.62	464.25	490.88	484.37	461.76	432.76	400.27	371.8	359.4	361.08	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.94	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.53	19.78	20.15	20.53	20.82	20.94	20.92	20.69	20.23	19.76	19.38	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.9	0.74	0.53	0.58	0.85	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=	17.61	17.79	18.16	18.7	19.23	19.6	19.7	19.69	19.46	18.83	18.14	17.58	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.07	18.24	18.58	19.07	19.56	19.91	20.02	20.01	19.77	19.19	18.55	18.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.07	18.24	18.58	19.07	19.56	19.91	20.02	20.01	19.77	19.19	18.55	18.04	(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	0.96	0.9	0.75	0.57	0.62	0.86	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.26	397.41	421.86	444.95	439.91	365.46	262.04	269.86	343.42	358.7	355.2	358.92	(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=	1134.95	1097.3	992.05	828.64	639.04	428	275.77	290.3	459.02	698.18	934.59	1133.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	567.44	470.32	424.22	276.26	148.16	0	0	0	0	252.57	417.16	576.14	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3132.28 (98)

Space heating requirement in kWh/m²/year 56.33 (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.77	0	0	0	0	(101)

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Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	546.9	481.43	472.55	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	623.42	595.88	562.73	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	0	85.15	67.09	0	0	0	0

Total = Sum(104) = 152.24 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.68 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.55	11.46	0	0	0	0

Total = Sum(107) = 26.01 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.47 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		3132.28	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	427.56	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2861.34	(307b)
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		1882.19	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	256.92	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1719.38	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	52.65	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)

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Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =				5.5	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside					92.61	(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) =				92.61	(331)
Energy for lighting (calculated in Appendix L)					254.67	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit						30.6	(361)
Heat efficiency of CHP unit						63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**		**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	678.66	x	0.22		146.59	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	207.67	x	0.52		-107.78	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	0.22		88.09	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	0.52		-64.77	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1023.2	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	27.33	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1112.66	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1112.66	(376)
CO2 associated with space cooling	(315) x			0.52	=	2.86	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	48.06	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	132.18	(379)
Total CO2, kg/year	sum of (376)…(382) =					1295.75	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					23.3	(384)
EI rating (section 14)						82.74	(385)

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User Details:

Assessor Name: Chris Hocknell **Stroma Number:** STRO016363
Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.4.10

Property Address: Flat 0-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.25	(1a)	x	3.1	(2a)	=	134.07	(3a)
Ground floor	63.89	(1b)	x	2.6	(2b)	=	166.11	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	107.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	300.19	(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

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

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.16	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.25	x	0.11	=	4.7575			(28)
Floor Type 2			31.9	x	0.11	=	3.509			(28)
Walls Type1	77.32	34.06	43.26	x	0.15	=	6.49			(29)
Walls Type2	20.68	0	20.68	x	0.15	=	3.1			(29)
Walls Type3	43.4	0	43.4	x	0.15	=	6.51			(29)
Walls Type4	28.22	0	28.22	x	0.15	=	4.23			(29)
Walls Type5	6.27	0	6.27	x	0.15	=	0.94			(29)
Roof Type1	11.42	0	11.42	x	0.15	=	1.71			(30)
Roof Type2	4.83	0	4.83	x	0.15	=	0.72			(30)
Total area of elements, m²			267.29							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	59.06			(32b)

** 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) =	71.12	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	34247.85	(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		36.66	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	107.78	(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=	27.74	27.43	27.11	25.53	25.22	23.64	23.64	23.32	24.27	25.22	25.85	26.48	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.52	135.21	134.89	133.31	133	131.42	131.42	131.1	132.05	133	133.63	134.26	

Average = Sum(39)1…12 /12= 133.24 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.25	1.25	

Average = Sum(40)1…12 /12= 1.24 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.8 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.62 (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=	110.68	106.65	102.63	98.61	94.58	90.56	90.56	94.58	98.61	102.63	106.65	110.68	

Total = Sum(44)1…12 = 1207.41 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	164.13	143.55	148.13	129.15	123.92	106.93	99.09	113.71	115.06	134.1	146.38	158.96	

Total = Sum(45)1…12 = 1583.1 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.62	21.53	22.22	19.37	18.59	16.04	14.86	17.06	17.26	20.11	21.96	23.84	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23	(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=	219.41	193.48	203.41	182.64	179.2	160.43	154.37	168.98	168.56	189.37	199.87	214.23

Output from water heater (annual)1…12 — 2233.94 (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=	98.8	87.67	93.48	85.74	85.42	78.35	77.17	82.03	81.05	88.81	91.47	97.07	(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=	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	139.83	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	23.84	21.17	17.22	13.04	9.74	8.23	8.89	11.55	15.51	19.69	22.98	24.5	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	267.38	270.16	263.16	248.28	229.49	211.83	200.03	197.26	204.25	219.13	237.92	255.58	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(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=	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	-111.86	(71)

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Water heating gains (Table 5)

(72)m=	132.79	130.47	125.64	119.08	114.82	108.82	103.72	110.25	112.57	119.37	127.03	130.48	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	488.96	486.74	470.97	445.34	419	393.82	377.59	384.01	397.28	423.14	452.89	475.51	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

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Northeast 0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast 0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast 0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southeast 0.9x	0.77	x	3.51	x	36.79	x	0.24	x	0.7	=	15.04	(77)
Southeast 0.9x	0.77	x	3.51	x	62.67	x	0.24	x	0.7	=	25.61	(77)
Southeast 0.9x	0.77	x	3.51	x	85.75	x	0.24	x	0.7	=	35.04	(77)
Southeast 0.9x	0.77	x	3.51	x	106.25	x	0.24	x	0.7	=	43.42	(77)
Southeast 0.9x	0.77	x	3.51	x	119.01	x	0.24	x	0.7	=	48.63	(77)
Southeast 0.9x	0.77	x	3.51	x	118.15	x	0.24	x	0.7	=	48.28	(77)
Southeast 0.9x	0.77	x	3.51	x	113.91	x	0.24	x	0.7	=	46.55	(77)
Southeast 0.9x	0.77	x	3.51	x	104.39	x	0.24	x	0.7	=	42.66	(77)
Southeast 0.9x	0.77	x	3.51	x	92.85	x	0.24	x	0.7	=	37.94	(77)
Southeast 0.9x	0.77	x	3.51	x	69.27	x	0.24	x	0.7	=	28.31	(77)
Southeast 0.9x	0.77	x	3.51	x	44.07	x	0.24	x	0.7	=	18.01	(77)
Southeast 0.9x	0.77	x	3.51	x	31.49	x	0.24	x	0.7	=	12.87	(77)
Southwest 0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest 0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest 0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest 0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest 0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest 0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest 0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest 0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest 0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest 0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest 0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest 0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.84	124.4	189.19	266.22	327.21	337.62	320.19	272.73	215.56	142.61	83.76	58.07	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	557.8	611.15	660.16	711.56	746.21	731.44	697.78	656.74	612.84	565.75	536.64	533.58	(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	1	0.99	0.96	0.88	0.74	0.79	0.94	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.54	19.65	19.88	20.22	20.55	20.83	20.95	20.93	20.71	20.29	19.86	19.52	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.87	19.87	19.87	19.88	19.89	19.9	19.9	19.9	19.89	19.89	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.94	0.81	0.6	0.66	0.9	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.92	18.09	18.43	18.92	19.4	19.76	19.88	19.87	19.63	19.03	18.4	17.9	(90)

fLA = Living area ÷ (4) = 0.15 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.15	18.32	18.64	19.11	19.57	19.92	20.03	20.02	19.79	19.22	18.62	18.13	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.15	18.32	18.64	19.11	19.57	19.92	20.03	20.02	19.79	19.22	18.62	18.13	(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	1	0.99	0.98	0.93	0.81	0.62	0.67	0.9	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	556.42	608.62	654.5	695.26	695.66	590.73	429.55	441.82	550.66	555.4	534.2	532.52	(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=	1877.45	1814.53	1637.87	1361.03	1046.38	699.12	451.17	474.71	750.9	1146	1538.97	1870.88	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	982.84	810.37	731.62	479.36	260.93	0	0	0	0	439.41	723.43	995.74	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5423.71 (98)

Space heating requirement in kWh/m²/year 50.62 (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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		5423.71	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	740.34	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	4954.56	(307b)
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		2233.94	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	304.93	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2040.71	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	80.41	(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		247.21	(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) =	247.21	(331)
Energy for lighting (calculated in Appendix L)		420.97	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-228.98	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1175.14	x	0.22		253.83	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	359.59	x	0.52		-186.63	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	484.02	x	0.22		104.55	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.11	x	0.52		-76.87	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1562.54	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	41.73	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1699.15	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1699.15	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	128.3	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	218.48	(379)

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Energy saving/generation technologies (333) to (334) as applicable Item 1	0.52	x 0.01 =	-118.84	(380)
Total CO2, kg/year	sum of (376)…(382) =		1927.1	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		17.99	(384)
EI rating (section 14)			83.03	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 0-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	43.37	(1a)	x	3.1	(2a)	=	134.45	(3a)
Ground floor	66.91	(1b)	x	2.6	(2b)	=	173.97	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	110.28	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	308.41	(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

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			13.52	x1/[1/(1.2)+ 0.04]		=	15.48			(27)
Windows Type 2			2.73	x1/[1/(1.2)+ 0.04]		=	3.13			(27)
Windows Type 3			4.16	x1/[1/(1.2)+ 0.04]		=	4.76			(27)
Windows Type 4			7.54	x1/[1/(1.2)+ 0.04]		=	8.63			(27)
Windows Type 5			3.51	x1/[1/(1.2)+ 0.04]		=	4.02			(27)
Floor Type 1			43.37	x	0.11	=	4.7707			(28)
Floor Type 2			34.11	x	0.11	=	3.7521			(28)
Walls Type1	44.81	34.06	10.75	x	0.15	=	1.61			(29)
Walls Type2	3.2	0	3.2	x	0.15	=	0.48			(29)
Walls Type3	43.07	0	43.07	x	0.15	=	6.46			(29)
Walls Type4	28.33	0	28.33	x	0.15	=	4.25			(29)
Walls Type5	56.95	0	56.95	x	0.15	=	8.54			(29)
Roof Type1	10.57	0	10.57	x	0.15	=	1.59			(30)
Roof Type2	4.76	0	4.76	x	0.15	=	0.71			(30)
Total area of elements, m²			269.17							(31)
Party wall			13.7	x	0	=	0			(32)

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Party ceiling	62.16			(32b)

** 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) =	71.31	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	39475.97	(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		37.2	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	108.51	(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=	27.04	26.75	26.45	24.97	24.68	23.2	23.2	22.9	23.79	24.68	25.27	25.86	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	135.56	135.26	134.97	133.49	133.19	131.71	131.71	131.42	132.3	133.19	133.78	134.37	

Average = $Sum(39)_{1…12}$ /12= 133.41 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	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 — 2.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 101.09 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	111.2	107.16	103.11	99.07	95.03	90.98	90.98	95.03	99.07	103.11	107.16	111.2

Total = $Sum(44)_{1…12}$ = 1213.1 (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=	164.91	144.23	148.83	129.76	124.5	107.44	99.56	114.24	115.61	134.73	147.07	159.7

Total = $Sum(45)_{1…12}$ = 1590.57 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	24.74	21.63	22.32	19.46	18.68	16.12	14.93	17.14	17.34	20.21	22.06	23.96	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

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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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98	(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=	220.18	194.16	204.11	183.25	179.78	160.93	154.83	169.52	169.1	190	200.56	214.98

Output from water heater (annual)$_{1...12}$ — 2241.41 (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=	99.05	87.9	93.71	85.94	85.62	78.52	77.32	82.21	81.23	89.02	91.69	97.32	(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=	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	140.82	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	24.25	21.53	17.51	13.26	9.91	8.37	9.04	11.75	15.77	20.03	23.38	24.92	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	271.96	274.78	267.67	252.53	233.42	215.46	203.46	200.63	207.75	222.89	242	259.96	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	37.08	(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=	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	-112.66	(71)

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Water heating gains (Table 5)

(72)m=	133.14	130.8	125.95	119.36	115.08	109.05	103.93	110.49	112.83	119.65	127.35	130.81	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	494.59	492.36	476.38	450.39	423.65	398.12	381.67	388.13	401.59	427.81	457.97	480.94	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.54	x	13.52	x	11.28	x	0.24	x	0.7	=	12.46	(75)
Northeast 0.9x	0.77	x	2.73	x	11.28	x	0.24	x	0.7	=	3.59	(75)
Northeast 0.9x	0.77	x	4.16	x	11.28	x	0.24	x	0.7	=	5.46	(75)
Northeast 0.9x	0.54	x	13.52	x	22.97	x	0.24	x	0.7	=	25.35	(75)
Northeast 0.9x	0.77	x	2.73	x	22.97	x	0.24	x	0.7	=	7.3	(75)
Northeast 0.9x	0.77	x	4.16	x	22.97	x	0.24	x	0.7	=	11.12	(75)
Northeast 0.9x	0.54	x	13.52	x	41.38	x	0.24	x	0.7	=	45.68	(75)
Northeast 0.9x	0.77	x	2.73	x	41.38	x	0.24	x	0.7	=	13.15	(75)
Northeast 0.9x	0.77	x	4.16	x	41.38	x	0.24	x	0.7	=	20.04	(75)
Northeast 0.9x	0.54	x	13.52	x	67.96	x	0.24	x	0.7	=	75.02	(75)
Northeast 0.9x	0.77	x	2.73	x	67.96	x	0.24	x	0.7	=	21.6	(75)
Northeast 0.9x	0.77	x	4.16	x	67.96	x	0.24	x	0.7	=	32.91	(75)
Northeast 0.9x	0.54	x	13.52	x	91.35	x	0.24	x	0.7	=	100.84	(75)
Northeast 0.9x	0.77	x	2.73	x	91.35	x	0.24	x	0.7	=	29.03	(75)
Northeast 0.9x	0.77	x	4.16	x	91.35	x	0.24	x	0.7	=	44.24	(75)
Northeast 0.9x	0.54	x	13.52	x	97.38	x	0.24	x	0.7	=	107.5	(75)
Northeast 0.9x	0.77	x	2.73	x	97.38	x	0.24	x	0.7	=	30.95	(75)
Northeast 0.9x	0.77	x	4.16	x	97.38	x	0.24	x	0.7	=	47.17	(75)
Northeast 0.9x	0.54	x	13.52	x	91.1	x	0.24	x	0.7	=	100.56	(75)
Northeast 0.9x	0.77	x	2.73	x	91.1	x	0.24	x	0.7	=	28.96	(75)
Northeast 0.9x	0.77	x	4.16	x	91.1	x	0.24	x	0.7	=	44.12	(75)
Northeast 0.9x	0.54	x	13.52	x	72.63	x	0.24	x	0.7	=	80.17	(75)
Northeast 0.9x	0.77	x	2.73	x	72.63	x	0.24	x	0.7	=	23.08	(75)
Northeast 0.9x	0.77	x	4.16	x	72.63	x	0.24	x	0.7	=	35.17	(75)
Northeast 0.9x	0.54	x	13.52	x	50.42	x	0.24	x	0.7	=	55.66	(75)
Northeast 0.9x	0.77	x	2.73	x	50.42	x	0.24	x	0.7	=	16.03	(75)
Northeast 0.9x	0.77	x	4.16	x	50.42	x	0.24	x	0.7	=	24.42	(75)
Northeast 0.9x	0.54	x	13.52	x	28.07	x	0.24	x	0.7	=	30.98	(75)
Northeast 0.9x	0.77	x	2.73	x	28.07	x	0.24	x	0.7	=	8.92	(75)
Northeast 0.9x	0.77	x	4.16	x	28.07	x	0.24	x	0.7	=	13.59	(75)
Northeast 0.9x	0.54	x	13.52	x	14.2	x	0.24	x	0.7	=	15.67	(75)
Northeast 0.9x	0.77	x	2.73	x	14.2	x	0.24	x	0.7	=	4.51	(75)

Northeast 0.9x	0.77	x	4.16	x	14.2	x	0.24	x	0.7	=	6.88	(75)
Northeast 0.9x	0.54	x	13.52	x	9.21	x	0.24	x	0.7	=	10.17	(75)
Northeast 0.9x	0.77	x	2.73	x	9.21	x	0.24	x	0.7	=	2.93	(75)
Northeast 0.9x	0.77	x	4.16	x	9.21	x	0.24	x	0.7	=	4.46	(75)
Southwest 0.9x	0.77	x	7.54	x	36.79		0.24	x	0.7	=	32.3	(79)
Southwest 0.9x	0.77	x	7.54	x	62.67		0.24	x	0.7	=	55.02	(79)
Southwest 0.9x	0.77	x	7.54	x	85.75		0.24	x	0.7	=	75.28	(79)
Southwest 0.9x	0.77	x	7.54	x	106.25		0.24	x	0.7	=	93.27	(79)
Southwest 0.9x	0.77	x	7.54	x	119.01		0.24	x	0.7	=	104.47	(79)
Southwest 0.9x	0.77	x	7.54	x	118.15		0.24	x	0.7	=	103.72	(79)
Southwest 0.9x	0.77	x	7.54	x	113.91		0.24	x	0.7	=	99.99	(79)
Southwest 0.9x	0.77	x	7.54	x	104.39		0.24	x	0.7	=	91.64	(79)
Southwest 0.9x	0.77	x	7.54	x	92.85		0.24	x	0.7	=	81.51	(79)
Southwest 0.9x	0.77	x	7.54	x	69.27		0.24	x	0.7	=	60.81	(79)
Southwest 0.9x	0.77	x	7.54	x	44.07		0.24	x	0.7	=	38.69	(79)
Southwest 0.9x	0.77	x	7.54	x	31.49		0.24	x	0.7	=	27.64	(79)
Northwest 0.9x	0.77	x	3.51	x	11.28	x	0.24	x	0.7	=	4.61	(81)
Northwest 0.9x	0.77	x	3.51	x	22.97	x	0.24	x	0.7	=	9.39	(81)
Northwest 0.9x	0.77	x	3.51	x	41.38	x	0.24	x	0.7	=	16.91	(81)
Northwest 0.9x	0.77	x	3.51	x	67.96	x	0.24	x	0.7	=	27.77	(81)
Northwest 0.9x	0.77	x	3.51	x	91.35	x	0.24	x	0.7	=	37.33	(81)
Northwest 0.9x	0.77	x	3.51	x	97.38	x	0.24	x	0.7	=	39.8	(81)
Northwest 0.9x	0.77	x	3.51	x	91.1	x	0.24	x	0.7	=	37.23	(81)
Northwest 0.9x	0.77	x	3.51	x	72.63	x	0.24	x	0.7	=	29.68	(81)
Northwest 0.9x	0.77	x	3.51	x	50.42	x	0.24	x	0.7	=	20.6	(81)
Northwest 0.9x	0.77	x	3.51	x	28.07	x	0.24	x	0.7	=	11.47	(81)
Northwest 0.9x	0.77	x	3.51	x	14.2	x	0.24	x	0.7	=	5.8	(81)
Northwest 0.9x	0.77	x	3.51	x	9.21	x	0.24	x	0.7	=	3.77	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	58.42	108.18	171.06	250.57	315.91	329.13	310.86	259.75	198.22	125.77	71.55	48.97	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	553	600.54	647.44	700.96	739.56	727.25	692.54	647.87	599.81	553.58	529.52	529.9	(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	1	0.99	0.96	0.88	0.75	0.8	0.95	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.56	19.67	19.9	20.22	20.56	20.83	20.95	20.93	20.71	20.3	19.88	19.55	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.9	19.9	19.9	19.91	19.91	19.92	19.92	19.93	19.92	19.91	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	1	0.99	0.95	0.81	0.61	0.67	0.91	0.99	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.98	18.14	18.47	18.95	19.43	19.79	19.9	19.89	19.65	19.06	18.45	17.96	(90)

fLA = Living area ÷ (4) = 0.14 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.2	18.36	18.67	19.13	19.59	19.94	20.05	20.04	19.8	19.23	18.65	18.18	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.2	18.36	18.67	19.13	19.59	19.94	20.05	20.04	19.8	19.23	18.65	18.18	(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	1	0.99	0.98	0.94	0.82	0.62	0.69	0.91	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	551.87	598.52	642.85	687.01	693.46	592.99	432.47	443.82	545.07	545.07	527.51	529.03	(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=	1884.25	1820.18	1642.49	1365.54	1050.37	702.89	454.31	477.83	753.68	1149.8	1545.14	1878.77	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	991.29	820.95	743.73	488.54	265.54	0	0	0	0	449.92	732.69	1004.21	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 5496.88 (98)

Space heating requirement in kWh/m²/year 49.84 (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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		5496.88	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	750.32	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	5021.4	(307b)
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		2241.41	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	305.95	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	2047.53	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	81.25	(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		253.98	(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) =	253.98	(331)
Energy for lighting (calculated in Appendix L)		428.18	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-235.75	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1190.99	x	0.22		257.25	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	364.44	x	0.52		-189.15	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	485.64	x	0.22		104.9	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	148.61	x	0.52		-77.13	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1578.99	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	42.17	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1717.04	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1717.04	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	131.81	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	222.22	(379)

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Energy saving/generation technologies (333) to (334) as applicable Item 1	0.52	x 0.01 =	-122.35	(380)
Total CO2, kg/year sum of (376)…(382) =			1948.73	(383)
Dwelling CO2 Emission Rate (383) ÷ (4) =			17.67	(384)
EI rating (section 14)			83.18	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	192.56	(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) =	76.5	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.69	x	0.11	=	1.6159			(28)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			112.87							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			59.37							(32a)
Party ceiling			74.06							(32b)

** 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) =	39.55	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	27754.95	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K	18.19	(36)

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if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 57.74 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75.53	75.33	75.13	74.12	73.91	72.9	72.9	72.7	73.31	73.91	74.32	74.72	

Average = $Sum(39)_{1...12}$ /12= 74.07 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.02	1.02	1.01	1	1	0.98	0.98	0.98	0.99	1	1	1.01	

Average = $Sum(40)_{1...12}$ /12= 1 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ — 2063.55 (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.91	0.75	0.57	0.62	0.87	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.06	20.26	20.54	20.8	20.96	20.99	20.99	20.89	20.57	20.22	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.07	20.07	20.07	20.08	20.08	20.1	20.1	20.1	20.09	20.08	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.96	0.87	0.66	0.46	0.51	0.8	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=	18.66	18.82	19.12	19.53	19.88	20.06	20.09	20.09	20	19.58	19.06	18.64	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19	19.15	19.42	19.8	20.12	20.3	20.33	20.33	20.23	19.84	19.37	18.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19	19.15	19.42	19.8	20.12	20.3	20.33	20.33	20.23	19.84	19.37	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=	1	0.99	0.98	0.96	0.87	0.68	0.49	0.54	0.82	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.45	486.09	516.24	538.32	514.26	395.73	269.42	281.3	396.19	436.36	431.29	433.93	(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=	1110.28	1073.13	970.35	807.72	622.56	415.42	271.85	285.52	449.57	683.17	911.67	1104.48	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	490.17	394.49	337.86	193.97	80.58	0	0	0	0	183.63	345.87	498.89

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2525.45 (98)

Space heating requirement in kWh/m²/year 34.1 (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	685.27	539.47	552.51	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.89	0.94	0.93	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	608.06	508.87	511.09	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	103.63	156.51	127.74	0	0	0	0	

Total = Sum(104)6...8 = 387.89 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.6 (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	15.57	23.51	19.19	0	0	0	0

Total = Sum(107)6...8 = 58.27 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.79 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2525.45	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	344.72	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2307	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	48.18	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.33	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	547.18	x	0.22	118.19	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	167.44	x	0.52	-86.9	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22	96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52	-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22 =	936.38	(368)
Electrical energy for heat distribution	[(313) x			0.52 =	25.01	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1018.25	(373)
CO2 associated with space heating (secondary)	(309) x			0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1018.25	(376)
CO2 associated with space cooling	(315) x			0.52 =	6.4	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52 =	82.3	(378)

CO2 associated with electricity for lighting	(332))) x	0.52	=	168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =			1193.65	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.12	(384)
EI rating (section 14)				86.57	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 1-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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) =	76.5	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

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)

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]

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Floor			14.36	x	0.11	=	1.5796			(28)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			111.88							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			61.7							(32a)
Party ceiling			76.06							(32b)

** 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) =	39.42	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	27990.6	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 18.24 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 57.66 | (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	75	74.81	74.62	73.67	73.48	72.53	72.53	72.34	72.91	73.48	73.86	74.24	

Average = $Sum(39)_{1...12}$ /12= | 73.62 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98

Average = $Sum(40)_{1...12}$ /12= | 0.97 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.38 | (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 | 90.82 | (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = $Sum(44)_{1...12}$ = | 1089.8 | (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = $Sum(45)_{1...12}$ = | 1428.9 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	

Output from water heater (annual)1…12 — 2079.74 (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.9	0.74	0.56	0.62	0.86	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.99	20.1	20.29	20.57	20.82	20.96	20.99	20.99	20.9	20.6	20.25	19.97	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.1	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.87	0.66	0.46	0.51	0.8	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=	18.74	18.9	19.18	19.59	19.92	20.09	20.12	20.12	20.03	19.63	19.13	18.72	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.06	19.2	19.47	19.84	20.15	20.32	20.34	20.34	20.25	19.88	19.42	19.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.06	19.2	19.47	19.84	20.15	20.32	20.34	20.34	20.25	19.88	19.42	19.04	(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	0.96	0.87	0.68	0.48	0.54	0.81	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.75	492.4	522.36	543.92	518.18	396.76	269.39	281.48	398.9	441.56	437.05	440.01	(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=	1106.97	1069.98	967.54	805.76	620.97	414.55	271.47	285.14	448.72	681.83	909.67	1101.74	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	483.02	388.13	331.21	188.52	76.47	0	0	0	0	178.77	340.28	492.33

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2478.73 (98)

Space heating requirement in kWh/m²/year 32.59 (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	681.81	536.74	549.81	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.9	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	610.8	509.45	512.46	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	106.88	161.24	131.96	0	0	0	0

Total = Sum(104)$_{6...8}$ = 400.08 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	15.63	23.58	19.3	0	0	0	0

Total = Sum(107)$_{6...8}$ = 58.52 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.77 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2478.73	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	338.35	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2264.32	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	47.86	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	12.38	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	537.06	x	0.22		116	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	164.34	x	0.52		-85.29	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	930.15	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.84	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1011.48	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1011.48	(376)
CO2 associated with space cooling	(315) x			0.52	=	6.43	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)

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CO2 associated with electricity for lighting	(332))) x	0.52	=	172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =			1190.51	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			15.65	(384)
EI rating (section 14)				86.82	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	74.06	(1a)	x	2.6	(2a)	=	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	192.56	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Total area of elements, m²			98.18							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			74.06							(32b)

** 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) = 37.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 27828.4 (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 11.04 (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) = **48.97** (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.77	66.57	66.36	65.35	65.15	64.14	64.14	63.93	64.54	65.15	65.55	65.96	

Average = $Sum(39)_{1...12}$ /12= **65.3** (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.89	0.89	

Average = $Sum(40)_{1...12}$ /12= **0.88** (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N **2.34** (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 **89.79** (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = $Sum(44)_{1...12}$ = **1077.45** (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = $Sum(45)_{1...12}$ = **1412.71** (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(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	0.68	0.51	0.56	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=	20.12	20.22	20.41	20.67	20.88	20.98	21	21	20.94	20.68	20.36	20.1	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.17	20.17	20.17	20.18	20.18	20.2	20.2	20.2	20.19	20.18	20.18	20.18	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.83	0.61	0.42	0.46	0.76	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=	18.98	19.14	19.41	19.79	20.07	20.18	20.2	20.2	20.14	19.81	19.35	18.97	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.42	19.67	20.02	20.28	20.39	20.41	20.41	20.35	20.04	19.62	19.27	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.42	19.67	20.02	20.28	20.39	20.41	20.41	20.35	20.04	19.62	19.27	(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	0.95	0.84	0.63	0.44	0.49	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.4	485.81	515.02	532.37	494.54	363.28	243.33	254.71	375.02	432.78	430.93	433.91	(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=	1000.34	966.7	874.16	726.52	558.89	371.5	244.09	256.14	403.5	615.07	820.41	993.72	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	408.42	323.16	267.2	139.79	47.88	0	0	0	0	135.63	280.42	416.5

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2018.99 (98)

Space heating requirement in kWh/m²/year 27.26 (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	602.87	474.6	485.89	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.94	0.97	0.96	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.25	462.49	468.37	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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	133.74	191.02	159.52	0	0	0	0

Total = Sum(104)$_{6...8}$ = 484.28 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (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	20.09	28.69	23.96	0	0	0	0

Total = Sum(107)$_{6...8}$ = 72.75 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.98 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2018.99	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	275.59	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1844.35	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.87	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.4	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	437.45	x	0.22		94.49	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	133.86	x	0.52		-69.47	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	833.04	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.25	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	905.87	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					905.87	(376)
CO2 associated with space cooling	(315) x			0.52	=	7.99	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)

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CO2 associated with electricity for lighting	(332))) x	0.52	=	168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =			1082.86	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.62	(384)
EI rating (section 14)				87.81	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 2-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	76.06	(1a) x	2.6	(2a) =	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		197.76	(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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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) =	76.5	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

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)

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]

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)
(25)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Total area of elements, m²			97.52							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			76.06							(32b)

** 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) =	37.84	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	28062.4	(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	(36)

DER WorkSheet: New dwelling design stage

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 48.84 (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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	66.18	65.99	65.8	64.85	64.66	63.71	63.71	63.52	64.09	64.66	65.04	65.42	

Average = Sum(39)$_{1…12}$ /12= 64.8 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.84	0.85	0.86	0.86	

Average = Sum(40)$_{1…12}$ /12= 0.85 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75

Output from water heater (annual)$_{1...12}$ | 2079.74 | (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(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	0.68	0.5	0.55	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=	20.16	20.26	20.44	20.69	20.89	20.98	21	21	20.95	20.7	20.39	20.14	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.19	20.2	20.2	20.21	20.21	20.22	20.22	20.22	20.22	20.21	20.21	20.2	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.95	0.83	0.6	0.41	0.46	0.75	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=	19.06	19.21	19.47	19.84	20.1	20.21	20.22	20.22	20.17	19.86	19.41	19.04	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.34	19.48	19.72	20.05	20.3	20.41	20.42	20.42	20.37	20.08	19.66	19.32	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.34	19.48	19.72	20.05	20.3	20.41	20.42	20.42	20.37	20.08	19.66	19.32	(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	0.95	0.83	0.62	0.44	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.68	492.09	521.03	537.49	497.01	362.92	242.69	254.15	376.3	437.65	436.65	439.98	(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=	995.46	962.03	869.97	723.39	556.33	370.01	243.3	255.32	401.92	612.72	817.11	989.42	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	400.11	315.8	259.61	133.85	44.13	0	0	0	0	130.25	273.93	408.79

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1966.47 (98)

Space heating requirement in kWh/m²/year 25.85 (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	598.91	471.48	482.78	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.95	0.98	0.97	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	566.6	461.21	467.74	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	138.71	197.13	165.24	0	0	0	0

Total = Sum(104)$_{6...8}$ = 501.07 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.59 (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	20.29	28.83	24.17	0	0	0	0

Total = Sum(107)$_{6...8}$ = 73.29 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.96 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		1966.47	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	268.42	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1796.37	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.49	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	15.51	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	426.07	x	0.22		92.03	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	130.38	x	0.52		-67.67	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	825.63	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	22.05	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	897.81	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					897.81	(376)
CO2 associated with space cooling	(315) x			0.52	=	8.05	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)

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CO2 associated with electricity for lighting	(332))) x		0.52	=	172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52		x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =				1078.47	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.18	(384)
EI rating (section 14)					88.06	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	74.06	(1a) x	2.6	(2a) =	192.56	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	74.06	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		192.56	(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

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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	67.78	20.58	47.2	x	0.15	=	7.08			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	5.93	0	5.93	x	0.15	=	0.89			(29)
Roof	19.72	0	19.72	x	0.15	=	2.96			(30)
Total area of elements, m²			117.9							(31)
Party wall			12.38	x	0	=	0			(32)
Party floor			74.06							(32a)
Party ceiling			54.34							(32b)

** 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) = 40.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26033.88 (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 22.81 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 63.71 (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=	17.8	17.59	17.39	16.38	16.18	15.16	15.16	14.96	15.57	16.18	16.58	16.99	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.5	81.3	81.1	80.08	79.88	78.87	78.87	78.67	79.27	79.88	80.29	80.69	

Average = Sum(39)$_{1...12}$ /12= 80.03 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.1	1.1	1.1	1.08	1.08	1.06	1.06	1.06	1.07	1.08	1.08	1.09	

Average = Sum(40)$_{1...12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.34 (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 89.79 (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=	98.77	95.17	91.58	87.99	84.4	80.81	80.81	84.4	87.99	91.58	95.17	98.77	

Total = Sum(44)$_{1...12}$ = 1077.45 (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=	146.47	128.1	132.19	115.25	110.58	95.42	88.42	101.47	102.68	119.66	130.62	141.85	

Total = Sum(45)$_{1...12}$ = 1412.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.97	19.22	19.83	17.29	16.59	14.31	13.26	15.22	15.4	17.95	19.59	21.28	(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=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	201.74	178.03	187.47	168.74	165.86	148.92	143.7	156.74	156.17	174.94	184.11	197.12

Output from water heater (annual)$_{1...12}$ | 2063.55 | (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=	92.92	82.54	88.17	81.11	80.99	74.52	73.62	77.96	76.94	84.01	86.23	91.39	(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=	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	117.03	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.42	16.36	13.3	10.07	7.53	6.36	6.87	8.93	11.98	15.21	17.76	18.93	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	206.58	208.73	203.32	191.82	177.31	163.66	154.55	152.4	157.81	169.31	183.82	197.47	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	34.7	(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=	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	-93.62	(71)

Water heating gains (Table 5)

(72)m=	124.9	122.82	118.51	112.66	108.86	103.5	98.95	104.78	106.86	112.92	119.76	122.83	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	408	406.01	393.25	372.66	351.8	331.63	318.48	324.22	334.75	355.54	379.45	397.33	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast 0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast 0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast 0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast 0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast 0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast 0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast 0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast 0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast 0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast 0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast 0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast 0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast 0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast 0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast 0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast 0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast 0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast 0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast 0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast 0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast 0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast 0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast 0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest 0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest 0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest 0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest 0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest 0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest 0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest 0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest 0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest 0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest 0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest 0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest 0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest 0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest 0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest 0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	453.33	489.52	524.22	562.95	590.51	579.86	553.11	521.02	485.99	452.34	434.89	435.38	(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	0.98	0.92	0.78	0.61	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.84	19.95	20.16	20.46	20.74	20.93	20.99	20.98	20.85	20.5	20.12	19.82	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.02	20.02	20.03	20.03	20.03	20.03	20.02	20.01	20.01	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.54	0.83	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=	18.45	18.61	18.92	19.36	19.75	19.98	20.02	20.02	19.9	19.43	18.88	18.43	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.81	18.96	19.25	19.65	20.01	20.23	20.28	20.27	20.15	19.71	19.2	18.79	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.81	18.96	19.25	19.65	20.01	20.23	20.28	20.27	20.15	19.71	19.2	18.79	(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	0.96	0.89	0.71	0.52	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	451.43	486.15	516.68	540.75	523.21	413.46	285.5	297.27	406.34	437.8	431.39	433.9	(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=	1182.88	1143.39	1033.77	861.04	664.04	444.04	289.93	304.65	479.42	727.84	971.82	1177.62	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	544.2	441.67	384.71	230.61	104.78	0	0	0	0	215.79	389.11	553.33

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2864.18 (98)

Space heating requirement in kWh/m²/year 38.67 (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	741.37	583.63	597.87	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.89	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	628.97	534.61	533.86	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	751.99	719.24	682.78	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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(104)m=	0	0	0	0	0	88.58	137.36	110.8	0	0	0	0

Total = Sum(104)$_{6...8}$ = 336.73 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.6 (105)

Intermittency factor (Table 10b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(107)m=	0	0	0	0	0	13.31	20.63	16.64	0	0	0	0

Total = Sum(107)$_{6...8}$ = 50.58 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.68 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2864.18	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	390.96	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2616.43	(307b)
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		2063.55	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	281.67	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1885.05	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.74	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.71	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		158.57	(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) =	158.57	(331)
Energy for lighting (calculated in Appendix L)		325.25	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-158.19	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		30.6	(361)
Heat efficiency of CHP unit		63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	620.57	x	0.22		134.04	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	189.9	x	0.52		-98.56	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	447.1	x	0.22		96.57	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	136.81	x	0.52		-71.01	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1005.5	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	26.85	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1093.41	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1093.41	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.56	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	82.3	(378)

CO2 associated with electricity for lighting	(332))) x	0.52	=	168.8	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-82.1	(380)
Total CO2, kg/year	sum of (376)…(382) =			1267.97	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			17.12	(384)
EI rating (section 14)				85.73	(385)

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User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 3-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	76.06	(1a)	x	2.6	(2a)	=	197.76	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.06	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	197.76	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			3.26	x1/[1/(1.2)+ 0.04]		=	3.73			(27)
Windows Type 2			3.95	x1/[1/(1.2)+ 0.04]		=	4.52			(27)
Windows Type 3			5.51	x1/[1/(1.2)+ 0.04]		=	6.31			(27)
Windows Type 4			0.65	x1/[1/(1.2)+ 0.04]		=	0.74			(27)
Walls Type1	38.14	20.58	17.56	x	0.15	=	2.63			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	5.95	0	5.95	x	0.15	=	0.89			(29)
Walls Type4	29.51	0	29.51	x	0.15	=	4.43			(29)
Roof	20.45	0	20.45	x	0.15	=	3.07			(30)
Total area of elements, m²			117.97							(31)
Party wall			12.35	x	0	=	0			(32)
Party floor			76.06							(32a)
Party ceiling			55.61							(32b)

** 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) = 40.9 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 26201.45 (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		23.27	(36)
if details of thermal bridging are not known (36) = 0.15 x (31)			
Total fabric heat loss	(33) + (36) =	64.17	(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=	17.34	17.15	16.96	16.01	15.82	14.88	14.88	14.69	15.25	15.82	16.2	16.58	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	81.51	81.32	81.13	80.18	79.99	79.04	79.04	78.85	79.42	79.99	80.37	80.75	

Average = Sum(39)$_{1…12}$ /12= 80.13 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.07	1.07	1.07	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.06	1.06	

Average = Sum(40)$_{1…12}$ /12= 1.05 (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 2.38 (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 90.82 (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=	99.9	96.27	92.63	89	85.37	81.73	81.73	85.37	89	92.63	96.27	99.9	

Total = Sum(44)$_{1…12}$ = 1089.8 (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=	148.15	129.57	133.7	116.57	111.85	96.52	89.44	102.63	103.86	121.03	132.12	143.47	

Total = Sum(45)$_{1…12}$ = 1428.9 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.22	19.44	20.06	17.48	16.78	14.48	13.42	15.39	15.58	18.16	19.82	21.52	(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)

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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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	(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=	203.42	179.5	188.98	170.06	167.13	150.01	144.71	157.91	157.35	176.31	185.61	198.75	

Output from water heater (annual)$_{1...12}$ | 2079.74 | (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=	93.48	83.02	88.68	81.55	81.41	74.89	73.96	78.35	77.33	84.47	86.72	91.93	(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=	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	119.19	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.81	16.71	13.59	10.29	7.69	6.49	7.01	9.12	12.24	15.54	18.14	19.33	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.01	213.2	207.68	195.93	181.11	167.17	157.86	155.67	161.19	172.93	187.76	201.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(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=	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	-95.35	(71)

Water heating gains (Table 5)

(72)m=	125.65	123.55	119.19	113.27	109.42	104.01	99.41	105.3	107.4	113.53	120.45	123.56	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	414.22	412.21	399.22	378.25	356.98	336.43	323.04	328.85	339.58	360.76	385.11	403.35	(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	3.26	x	11.28	x	0.24	x	0.7	=	8.56	(75)
Northeast	0.9x	0.77	x	3.95	x	11.28	x	0.24	x	0.7	=	10.38	(75)
Northeast	0.9x	0.77	x	3.26	x	22.97	x	0.24	x	0.7	=	17.43	(75)
Northeast	0.9x	0.77	x	3.95	x	22.97	x	0.24	x	0.7	=	21.12	(75)
Northeast	0.9x	0.77	x	3.26	x	41.38	x	0.24	x	0.7	=	31.41	(75)
Northeast	0.9x	0.77	x	3.95	x	41.38	x	0.24	x	0.7	=	38.06	(75)
Northeast	0.9x	0.77	x	3.26	x	67.96	x	0.24	x	0.7	=	51.58	(75)
Northeast	0.9x	0.77	x	3.95	x	67.96	x	0.24	x	0.7	=	62.5	(75)
Northeast	0.9x	0.77	x	3.26	x	91.35	x	0.24	x	0.7	=	69.34	(75)
Northeast	0.9x	0.77	x	3.95	x	91.35	x	0.24	x	0.7	=	84.02	(75)
Northeast	0.9x	0.77	x	3.26	x	97.38	x	0.24	x	0.7	=	73.92	(75)
Northeast	0.9x	0.77	x	3.95	x	97.38	x	0.24	x	0.7	=	89.57	(75)
Northeast	0.9x	0.77	x	3.26	x	91.1	x	0.24	x	0.7	=	69.15	(75)
Northeast	0.9x	0.77	x	3.95	x	91.1	x	0.24	x	0.7	=	83.79	(75)
Northeast	0.9x	0.77	x	3.26	x	72.63	x	0.24	x	0.7	=	55.13	(75)
Northeast	0.9x	0.77	x	3.95	x	72.63	x	0.24	x	0.7	=	66.8	(75)
Northeast	0.9x	0.77	x	3.26	x	50.42	x	0.24	x	0.7	=	38.27	(75)
Northeast	0.9x	0.77	x	3.95	x	50.42	x	0.24	x	0.7	=	46.37	(75)
Northeast	0.9x	0.77	x	3.26	x	28.07	x	0.24	x	0.7	=	21.31	(75)
Northeast	0.9x	0.77	x	3.95	x	28.07	x	0.24	x	0.7	=	25.81	(75)
Northeast	0.9x	0.77	x	3.26	x	14.2	x	0.24	x	0.7	=	10.78	(75)
Northeast	0.9x	0.77	x	3.95	x	14.2	x	0.24	x	0.7	=	13.06	(75)
Northeast	0.9x	0.77	x	3.26	x	9.21	x	0.24	x	0.7	=	6.99	(75)
Northeast	0.9x	0.77	x	3.95	x	9.21	x	0.24	x	0.7	=	8.47	(75)
Southwest	0.9x	0.77	x	5.51	x	36.79		0.24	x	0.7	=	23.6	(79)
Southwest	0.9x	0.77	x	0.65	x	36.79		0.24	x	0.7	=	2.78	(79)
Southwest	0.9x	0.77	x	5.51	x	62.67		0.24	x	0.7	=	40.2	(79)
Southwest	0.9x	0.77	x	0.65	x	62.67		0.24	x	0.7	=	4.74	(79)
Southwest	0.9x	0.77	x	5.51	x	85.75		0.24	x	0.7	=	55.01	(79)
Southwest	0.9x	0.77	x	0.65	x	85.75		0.24	x	0.7	=	6.49	(79)
Southwest	0.9x	0.77	x	5.51	x	106.25		0.24	x	0.7	=	68.16	(79)
Southwest	0.9x	0.77	x	0.65	x	106.25		0.24	x	0.7	=	8.04	(79)
Southwest	0.9x	0.77	x	5.51	x	119.01		0.24	x	0.7	=	76.34	(79)
Southwest	0.9x	0.77	x	0.65	x	119.01		0.24	x	0.7	=	9.01	(79)
Southwest	0.9x	0.77	x	5.51	x	118.15		0.24	x	0.7	=	75.79	(79)
Southwest	0.9x	0.77	x	0.65	x	118.15		0.24	x	0.7	=	8.94	(79)
Southwest	0.9x	0.77	x	5.51	x	113.91		0.24	x	0.7	=	73.07	(79)
Southwest	0.9x	0.77	x	0.65	x	113.91		0.24	x	0.7	=	8.62	(79)
Southwest	0.9x	0.77	x	5.51	x	104.39		0.24	x	0.7	=	66.97	(79)

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Southwest	0.9x	0.77	x	0.65	x	104.39	0.24	x	0.7	=	7.9	(79)
Southwest	0.9x	0.77	x	5.51	x	92.85	0.24	x	0.7	=	59.56	(79)
Southwest	0.9x	0.77	x	0.65	x	92.85	0.24	x	0.7	=	7.03	(79)
Southwest	0.9x	0.77	x	5.51	x	69.27	0.24	x	0.7	=	44.43	(79)
Southwest	0.9x	0.77	x	0.65	x	69.27	0.24	x	0.7	=	5.24	(79)
Southwest	0.9x	0.77	x	5.51	x	44.07	0.24	x	0.7	=	28.27	(79)
Southwest	0.9x	0.77	x	0.65	x	44.07	0.24	x	0.7	=	3.34	(79)
Southwest	0.9x	0.77	x	5.51	x	31.49	0.24	x	0.7	=	20.2	(79)
Southwest	0.9x	0.77	x	0.65	x	31.49	0.24	x	0.7	=	2.38	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	45.33	83.51	130.97	190.29	238.71	248.23	234.64	196.79	151.24	96.8	55.44	38.05	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	459.55	495.72	530.19	568.54	595.68	584.66	557.68	525.64	490.82	457.56	440.55	441.4	(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	0.98	0.92	0.78	0.6	0.66	0.89	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.87	19.98	20.18	20.48	20.75	20.94	20.99	20.98	20.86	20.52	20.15	19.85	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.02	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.03	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.97	0.89	0.69	0.48	0.54	0.83	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=	18.51	18.67	18.98	19.41	19.79	20	20.05	20.04	19.93	19.47	18.93	18.49	(90)

fLA = Living area ÷ (4) = 0.26 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.86	19.01	19.28	19.68	20.03	20.24	20.29	20.28	20.16	19.74	19.24	18.84	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.86	19.01	19.28	19.68	20.03	20.24	20.29	20.28	20.16	19.74	19.24	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	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.99	0.96	0.89	0.71	0.52	0.57	0.84	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	457.74	492.49	522.88	546.7	528.43	416.75	287.26	299.3	410.53	443.22	437.18	439.99	(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=	1186.76	1147.19	1037.22	864.33	666.56	446.01	291.35	306.17	481.57	730.92	975.76	1182.11	(97)

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Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	542.39	439.96	382.66	228.69	102.77	0	0	0	0	214.05	387.78	552.14

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2850.45 (98)

Space heating requirement in kWh/m²/year 37.48 (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	743.01	584.92	599.29	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.85	0.92	0.9	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	634.58	538.46	538.26	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	759.25	726.17	689.83	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	89.76	139.66	112.76	0	0	0	0

Total = Sum(104)$_{6..8}$ = 342.18 (104)

Cooled fraction f C = cooled area ÷ (4) = 0.59 (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	13.13	20.43	16.49	0	0	0	0

Total = Sum(107)$_{6..8}$ = 50.05 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.66 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		2850.45	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	389.09	(307a)

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Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2603.88	(307b)
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		2079.74	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	283.88	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1899.84	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	51.77	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	10.59	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		162.85	(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) =	162.85	(331)
Energy for lighting (calculated in Appendix L)		332.22	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-162.5	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit	30.6	(361)
Heat efficiency of CHP unit	63	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	617.6	x	0.22		133.4	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	188.98	x	0.52		-98.08	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	450.61	x	0.22		97.33	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	137.89	x	0.52		-71.56	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	1006	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	26.87	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	1093.96	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					1093.96	(376)
CO2 associated with space cooling	(315) x			0.52	=	5.5	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	84.52	(378)

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CO2 associated with electricity for lighting	(332))) x	0.52	=	172.42	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 =	-84.34	(380)
Total CO2, kg/year	sum of (376)…(382) =			1272.06	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			16.72	(384)
EI rating (section 14)				85.92	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-1-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	54.34	(1a)	x	2.6	(2a)	=	141.28	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.34	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	141.28	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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	0.27	0.26	0.25	0.24	0.24	0.24	0.24	0.25	0.26	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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	59.86	17.24	42.62	x	0.15	=	6.39			(29)
Walls Type2	24.47	2.6	21.87	x	0.15	=	3.28			(29)
Walls Type3	2.57	0	2.57	x	0.15	=	0.39			(29)
Roof	54.34	0	54.34	x	0.15	=	8.15			(30)
Total area of elements, m²			141.24							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			54.34							(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) = 41.07 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17733.86 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 28.62 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 69.69 (37)

DER WorkSheet: New dwelling design stage

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=	13.06	12.91	12.76	12.02	11.87	11.13	11.13	10.98	11.42	11.87	12.17	12.46	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.75	82.6	82.45	81.71	81.56	80.81	80.81	80.66	81.11	81.56	81.85	82.15	

Average = Sum(39)$_{1…12}$ /12= 81.67 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.52	1.52	1.52	1.5	1.5	1.49	1.49	1.48	1.49	1.5	1.51	1.51	

Average = Sum(40)$_{1…12}$ /12= 1.5 (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 1.82 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 77.38 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	85.12	82.02	78.92	75.83	72.73	69.64	69.64	72.73	75.83	78.92	82.02	85.12

Total = Sum(44)$_{1…12}$ = 928.53 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	126.22	110.4	113.92	99.32	95.3	82.23	76.2	87.44	88.49	103.12	112.57	122.24

Total = Sum(45)$_{1…12}$ = 1217.45 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.93	16.56	17.09	14.9	14.29	12.34	11.43	13.12	13.27	15.47	16.89	18.34	(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)

DER WorkSheet: New dwelling design stage

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=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	181.5	160.32	169.2	152.81	150.57	135.73	131.48	142.72	141.98	158.4	166.06	177.52

Output from water heater (annual)$_{1...12}$ — 1868.29 (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=	86.19	76.65	82.1	75.82	75.91	70.14	69.56	73.3	72.22	78.51	80.22	84.87	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.13	12.55	10.21	7.73	5.78	4.88	5.27	6.85	9.19	11.67	13.62	14.52	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	158.48	160.13	155.98	147.16	136.02	125.56	118.56	116.92	121.06	129.89	141.02	151.49	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	32.09	(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=	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	-72.72	(71)

Water heating gains (Table 5)

(72)m=	115.85	114.06	110.35	105.3	102.03	97.41	93.49	98.52	100.3	105.52	111.42	114.07	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	338.73	337.01	326.81	310.46	294.1	278.12	267.6	272.55	280.83	297.35	316.34	330.35	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

DER WorkSheet: New dwelling design stage

Northeast	0.9x	0.77	x	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	370.11	396.7	425.05	459.97	486.91	480.69	458.26	429.2	396.55	367.79	355.06	356.47	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(86)m=	1	0.99	0.99	0.98	0.93	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.36	19.49	19.75	20.12	20.51	20.81	20.94	20.91	20.68	20.21	19.73	19.34	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.67	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.69	19.69	19.68	19.68	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.9	0.74	0.52	0.58	0.85	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=	17.53	17.71	18.09	18.64	19.18	19.56	19.67	19.66	19.42	18.77	18.07	17.5	(90)

fLA = Living area ÷ (4) = 0.25 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	17.99	18.16	18.51	19.01	19.51	19.87	19.99	19.98	19.73	19.13	18.48	17.96	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	17.99	18.16	18.51	19.01	19.51	19.87	19.99	19.98	19.73	19.13	18.48	17.96	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.98	0.96	0.89	0.75	0.57	0.62	0.86	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	367.38	392.51	417.04	440.27	435.54	362.05	259.6	267.23	339.64	354.44	350.71	354.22	(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=	1132.5	1094.9	989.8	826.4	637.1	426.11	273.9	288.39	456.98	695.8	931.89	1130.47	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	569.24	472	426.14	278.01	149.96	0	0	0	0	253.97	418.45	577.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3145.31 (98)

Space heating requirement in kWh/m²/year 57.88 (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	759.65	598.02	613.05	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.71	0.8	0.76	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	542.27	478.02	468.69	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	617.86	590.56	557.32	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	0	83.73	65.94	0	0	0	0	

Total = Sum(104)$_{6...8}$ = 149.67 (104)

DER WorkSheet: New dwelling design stage

Cooled fraction	f C = cooled area ÷ (4) =	0.7	(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) =	0	(106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.64	11.53	0	0	0	0

	Total = Sum(107) =	26.17	(107)
Space cooling requirement in kWh/m²/year	(107) ÷ (4) =	0.48	(108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		3145.31	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	429.33	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2873.24	(307b)
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		1868.29	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	255.02	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1706.68	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	52.64	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	5.54	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		90.49	(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) =	90.49	(331)

DER WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)		249.52	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-116.33	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	681.48	x	0.22	147.2	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	208.53	x	0.52	-108.23	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	404.8	x	0.22	87.44	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	123.87	x	0.52	-64.29	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22 =	1023.02	(368)
Electrical energy for heat distribution	[(313) x			0.52 =	27.32	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1112.46	(373)
CO2 associated with space heating (secondary)	(309) x			0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1112.46	(376)
CO2 associated with space cooling	(315) x			0.52 =	2.87	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52 =	46.97	(378)
CO2 associated with electricity for lighting	(332))) x			0.52 =	129.5	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52 x 0.01 =	-60.38	(380)
Total CO2, kg/year	sum of (376)…(382) =				1231.43	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				22.66	(384)
EI rating (section 14)					83.39	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Chris Hocknell	**Stroma Number:**	STRO016363
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.10

Property Address: Flat 4-2-Green

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	55.61	(1a) x	2.6	(2a) =	144.59	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	55.61	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	144.59	(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) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.24	0.25	0.25	(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			2.6	x	1.2	=	3.12			(26)
Windows Type 1			7.15	x1/[1/(1.2)+ 0.04]		=	8.19			(27)
Windows Type 2			2.19	x1/[1/(1.2)+ 0.04]		=	2.51			(27)
Windows Type 3			0.75	x1/[1/(1.2)+ 0.04]		=	0.86			(27)
Walls Type1	34.66	17.24	17.42	x	0.15	=	2.61			(29)
Walls Type2	23.92	2.6	21.32	x	0.15	=	3.2			(29)
Walls Type3	2.63	0	2.63	x	0.15	=	0.39			(29)
Walls Type4	25.13	0	25.13	x	0.15	=	3.77			(29)
Roof	55.61	0	55.61	x	0.15	=	8.34			(30)
Total area of elements, m²			141.95							(31)
Party wall			7.81	x	0	=	0			(32)
Party floor			55.61							(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) = 41.18 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17740.49 (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 28.57 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

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Total fabric heat loss	(33) + (36) =	69.75	(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=	12.68	12.54	12.4	11.71	11.57	10.88	10.88	10.74	11.15	11.57	11.85	12.12	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.42	82.28	82.15	81.45	81.31	80.62	80.62	80.48	80.9	81.31	81.59	81.87	

Average = $Sum(39)_{1…12}$ /12= 81.42 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.48	1.48	1.48	1.46	1.46	1.45	1.45	1.45	1.45	1.46	1.47	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 — 1.86 (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 — 78.26 (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=	86.09	82.96	79.83	76.7	73.57	70.44	70.44	73.57	76.7	79.83	82.96	86.09

Total = $Sum(44)_{1…12}$ = 939.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	127.67	111.66	115.22	100.45	96.39	83.17	77.07	88.44	89.5	104.3	113.85	123.64

Total = $Sum(45)_{1…12}$ = 1231.35 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	19.15	16.75	17.28	15.07	14.46	12.48	11.56	13.27	13.42	15.65	17.08	18.55	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91	(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=	182.94	161.58	170.5	153.94	151.66	136.67	132.35	143.72	142.99	159.58	167.35	178.91

Output from water heater (annual)$_{1...12}$ — 1882.19 (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=	86.67	77.07	82.53	76.2	76.27	70.45	69.85	73.63	72.55	78.9	80.65	85.33	(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=	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	92.76	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.42	12.81	10.42	7.89	5.89	4.98	5.38	6.99	9.38	11.91	13.9	14.82	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	161.76	163.43	159.2	150.2	138.83	128.15	121.01	119.33	123.56	132.57	143.94	154.62	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	32.28	(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=	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	-74.21	(71)

Water heating gains (Table 5)

(72)m=	116.49	114.68	110.93	105.83	102.51	97.85	93.88	98.96	100.77	106.05	112.02	114.69	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	343.5	341.76	331.38	314.74	298.07	281.8	271.1	276.11	284.54	301.36	320.68	334.96	(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	7.15	x	11.28	x	0.24	x	0.7	=	18.78	(75)
Northeast	0.9x	0.77	x	7.15	x	22.97	x	0.24	x	0.7	=	38.24	(75)
Northeast	0.9x	0.77	x	7.15	x	41.38	x	0.24	x	0.7	=	68.89	(75)
Northeast	0.9x	0.77	x	7.15	x	67.96	x	0.24	x	0.7	=	113.14	(75)
Northeast	0.9x	0.77	x	7.15	x	91.35	x	0.24	x	0.7	=	152.08	(75)
Northeast	0.9x	0.77	x	7.15	x	97.38	x	0.24	x	0.7	=	162.13	(75)
Northeast	0.9x	0.77	x	7.15	x	91.1	x	0.24	x	0.7	=	151.67	(75)
Northeast	0.9x	0.77	x	7.15	x	72.63	x	0.24	x	0.7	=	120.91	(75)
Northeast	0.9x	0.77	x	7.15	x	50.42	x	0.24	x	0.7	=	83.94	(75)
Northeast	0.9x	0.77	x	7.15	x	28.07	x	0.24	x	0.7	=	46.73	(75)
Northeast	0.9x	0.77	x	7.15	x	14.2	x	0.24	x	0.7	=	23.64	(75)
Northeast	0.9x	0.77	x	7.15	x	9.21	x	0.24	x	0.7	=	15.34	(75)
Southwest	0.9x	0.77	x	2.19	x	36.79		0.24	x	0.7	=	9.38	(79)
Southwest	0.9x	0.77	x	0.75	x	36.79		0.24	x	0.7	=	3.21	(79)
Southwest	0.9x	0.77	x	2.19	x	62.67		0.24	x	0.7	=	15.98	(79)
Southwest	0.9x	0.77	x	0.75	x	62.67		0.24	x	0.7	=	5.47	(79)
Southwest	0.9x	0.77	x	2.19	x	85.75		0.24	x	0.7	=	21.86	(79)
Southwest	0.9x	0.77	x	0.75	x	85.75		0.24	x	0.7	=	7.49	(79)
Southwest	0.9x	0.77	x	2.19	x	106.25		0.24	x	0.7	=	27.09	(79)
Southwest	0.9x	0.77	x	0.75	x	106.25		0.24	x	0.7	=	9.28	(79)
Southwest	0.9x	0.77	x	2.19	x	119.01		0.24	x	0.7	=	30.34	(79)
Southwest	0.9x	0.77	x	0.75	x	119.01		0.24	x	0.7	=	10.39	(79)
Southwest	0.9x	0.77	x	2.19	x	118.15		0.24	x	0.7	=	30.12	(79)
Southwest	0.9x	0.77	x	0.75	x	118.15		0.24	x	0.7	=	10.32	(79)
Southwest	0.9x	0.77	x	2.19	x	113.91		0.24	x	0.7	=	29.04	(79)
Southwest	0.9x	0.77	x	0.75	x	113.91		0.24	x	0.7	=	9.95	(79)
Southwest	0.9x	0.77	x	2.19	x	104.39		0.24	x	0.7	=	26.62	(79)
Southwest	0.9x	0.77	x	0.75	x	104.39		0.24	x	0.7	=	9.12	(79)
Southwest	0.9x	0.77	x	2.19	x	92.85		0.24	x	0.7	=	23.67	(79)
Southwest	0.9x	0.77	x	0.75	x	92.85		0.24	x	0.7	=	8.11	(79)
Southwest	0.9x	0.77	x	2.19	x	69.27		0.24	x	0.7	=	17.66	(79)
Southwest	0.9x	0.77	x	0.75	x	69.27		0.24	x	0.7	=	6.05	(79)
Southwest	0.9x	0.77	x	2.19	x	44.07		0.24	x	0.7	=	11.24	(79)
Southwest	0.9x	0.77	x	0.75	x	44.07		0.24	x	0.7	=	3.85	(79)
Southwest	0.9x	0.77	x	2.19	x	31.49		0.24	x	0.7	=	8.03	(79)
Southwest	0.9x	0.77	x	0.75	x	31.49		0.24	x	0.7	=	2.75	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	31.38	59.69	98.24	149.51	192.81	202.57	190.66	156.65	115.73	70.44	38.72	26.12	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	374.88	401.44	429.62	464.25	490.88	484.37	461.76	432.76	400.27	371.8	359.4	361.08	(84)

DER WorkSheet: New dwelling design stage

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.94	0.83	0.69	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.4	19.53	19.78	20.15	20.53	20.82	20.94	20.92	20.69	20.23	19.76	19.38	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.7	19.7	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.71	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.9	0.74	0.53	0.58	0.85	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=	17.61	17.79	18.16	18.7	19.23	19.6	19.7	19.69	19.46	18.83	18.14	17.58	(90)

fLA = Living area ÷ (4) = | 0.26 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.07	18.24	18.58	19.07	19.56	19.91	20.02	20.01	19.77	19.19	18.55	18.04	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.07	18.24	18.58	19.07	19.56	19.91	20.02	20.01	19.77	19.19	18.55	18.04	(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	0.96	0.9	0.75	0.57	0.62	0.86	0.96	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	372.26	397.41	421.86	444.95	439.91	365.46	262.04	269.86	343.42	358.7	355.2	358.92	(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=	1134.95	1097.3	992.05	828.64	639.04	428	275.77	290.3	459.02	698.18	934.59	1133.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	567.44	470.32	424.22	276.26	148.16	0	0	0	0	252.57	417.16	576.14	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 3132.28 | (98)

Space heating requirement in kWh/m²/year | 56.33 | (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	757.83	596.59	611.66	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.72	0.81	0.77	0	0	0	0	(101)

DER WorkSheet: New dwelling design stage

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	546.9	481.43	472.55	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	623.42	595.88	562.73	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	0	85.15	67.09	0	0	0	0

Total = Sum(104) = 152.24 (104)

Cooled fraction — f C = cooled area ÷ (4) = 0.68 (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) = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	0	14.55	11.46	0	0	0	0

Total = Sum(107) = 26.01 (107)

Space cooling requirement in kWh/m²/year — (107) ÷ (4) = 0.47 (108)

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 CHP		0.13	(303a)
Fraction of community heat from heat source 2		0.87	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.13	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.87	(304b)
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)
Space heating		**kWh/year**	
Annual space heating requirement		3132.28	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	427.56	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	2861.34	(307b)
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		1882.19	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	256.92	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1719.38	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	52.65	(313)
Cooling System Energy Efficiency Ratio		4.73	(314)

DER WorkSheet: New dwelling design stage

Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =				5.5	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside					92.61	(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) =				92.61	(331)
Energy for lighting (calculated in Appendix L)					254.67	(332)
Electricity generated by PVs (Appendix M) (negative quantity)					-118.8	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)					0	(334)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit					30.6	(361)
Heat efficiency of CHP unit					63	(362)
		Energy kWh/year		**Emission factor kg CO2/kWh**	**Emissions kg CO2/year**	
Space heating from CHP)	(307a) × 100 ÷ (362) =	678.66	x	0.22	146.59	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	207.67	x	0.52	-107.78	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	407.81	x	0.22	88.09	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	124.79	x	0.52	-64.77	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96.7	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	= 1023.2	(368)
Electrical energy for heat distribution	[(313) x			0.52	= 27.33	(372)
Total CO2 associated with community systems	(363)…(366) + (368)…(372)				= 1112.66	(373)
CO2 associated with space heating (secondary)	(309) x			0	= 0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	= 0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				1112.66	(376)
CO2 associated with space cooling	(315) x			0.52	= 2.86	(377)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	= 48.06	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	= 132.18	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1				0.52 x 0.01 =	-61.66	(380)
Total CO2, kg/year	sum of (376)…(382) =				1234.1	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				22.19	(384)
EI rating (section 14)					83.56	(385)

APPENDIX B – OVERHEATING REPORT

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Planning Statement
Overheating Analysis
Arthur Stanley House

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Disclaimer

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Introduction

Eight Associates has been appointed to undertake an overheating analysis for two duplex ground floor units of the Arthur Stanley house scheme in order to provide design stage guidance and maximise the occupant comfort level. Thermal modelling has been undertaken to demonstrate compliance with CIBSE TM52 and TM59 requirements. The current proposal plans to minimise overheating risk by following the Cooling Hierarchy.

Building Summary

The project consists of the development of a 5-storey residential building in the London Borough of Camden to create 10 residential units (including two affordable duplex units). The overheating analysis is performed for the two duplex units, which have a total gross internal area of approximately 220 m^2.

Planning Context

The London Borough of Camden does not set out any specific requirement for avoiding overheating. This report is aligned with national standards and regulations.

Methodology

The methodology used within this report is used to establish the thermal comfort levels in occupied spaces, through the use of a dynamic simulation and a response with suitable passive design measures to mitigate solar gains, provide adequate ventilation and increase thermal mass. National regulations have set high standards and numerous iterations have been undertaken to determine suitable fabric improvements. All assumptions used in the modelling are provided in the model inputs section of this report.

Please note that the climate change scenario has been excluded from this report. Note that external temperatures are likely to increase because of climate change. The consequences of increased summer peak temperatures could be non-compliance with the thermal comfort recommendations unless further measures were implemented.

Criteria for defining overheating

According to the CIBSE TM 52 – The limits of thermal comfort: avoiding overheating in European buildings (2013) and CIBSE Guide A – Environmental Design (2015), to reduce the risk of overheating the space has to comply with at least two of the following three criteria:

a. The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more, during the occupied hours of a typical non-heating season (1 May to 30 September).
b. The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.
c. The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

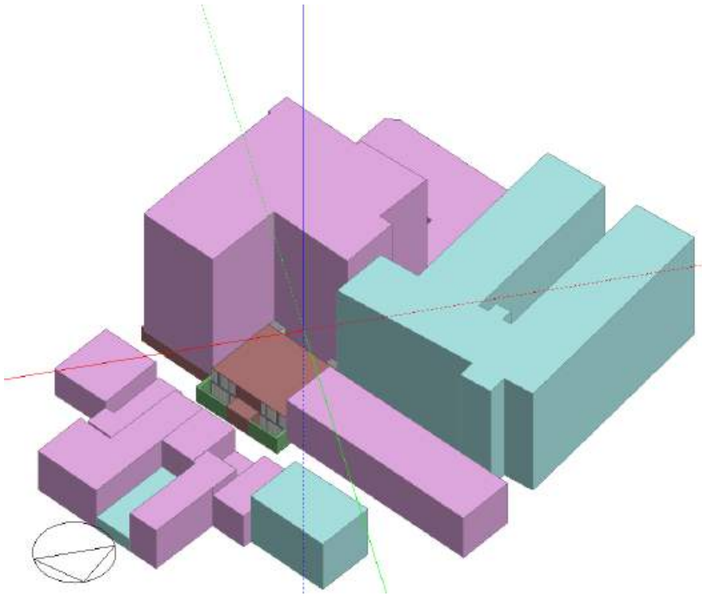
According to the CIBSE TM59: 2017 – Design methodology for the assessment of overheating risk in homes, to reduce the risk of overheating the space has to comply with the following criteria:

a. For living rooms, kitchen and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive, shall not be more than 3 per cent of occupied hours (Same as Criterion 1 of TM52).
b. For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of the annual hours (1% of the annual hours between 22:00 and 07:00).

Model Input
Overheating Analysis
Arthur Stanley House

Simulation Software

An overheating analysis has been undertaken using Dynamic Simulation Modelling, using Design Builder software. Design Builder is a DCLG approved simulation environment that complies with the requirements of CIBSE Guide A. A screenshot of the model is shown below.



Weather File

The CIBSE Design Summer Year (DSY) Current Series, London Heathrow, has been used for the purposes of this report.

Building Fabric U-Values

Element	Proposed U-value (W/m²K)
External walls	0.15
Ground floors	0.11
Roof	0.15
Openings	1.20

Internal Gains

Typical hours based on the relative activity for class use, on weekdays and weekends throughout the year have been specified for lighting, equipment and occupancy.

Space	Occupancy people/m²	Lighting W/m²	Small power W/m²
Bedroom	0.12 – 0.16	2	5.82 – 11.18
Kitchen	0.24	2	24.0
Living room	0.19	2	9.4

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Passive Design Measure
Overheating Analysis
Arthur Stanley House

Cooling Hierarchy

Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. Minimise internal heat generation through energy efficient design;
2. Reduce the amount of heat entering a building in summer through shading, albedo, fenestration, insulation and green roofs and walls;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Passive ventilation;
5. Mechanical ventilation;
6. Active cooling systems (ensuring they are the lowest carbon options).

Cooling Strategy

The cooling strategy is to implement energy efficient lighting and appliances to reduce internal heat gains; create a super-insulated fabric, solar control glazing to keep the heat out and openable windows to purge out the excess heat.

Windows

Glazing will be a crucial aspect to ensure thermal comfort of the occupied spaces. In order to minimise solar gains, and consequently cooling demand, windows with a solar factor of 0.24 have been modelled for every glazed area.

Mechanical Ventilation Rates

Mechanical ventilation with heat recovery and summer by pass has been specified. The system has to provide an air flow of 21 l/s (three-bedroom flats, as per Part F).

Natural Ventilation Rates

Natural ventilation through windows has been adopted for this scheme. The ventilation rate has been calculated by the software according to the percentage of openable windows for each space and the varying environmental conditions throughout the year. This percentage of the opening area has been estimated as follows:

Space	Glazing openable area
Living room	30%
Kitchen	30%
Double Bedroom 1	70%
Double Bedroom 2	30%
Single bedroom	90%

Moreover, the scheme has been modelled with a discharge coefficient rate of 0.65 and a wind factor of 1. The windows were open when the internal temperatures were above 22°C and when the rooms were occupied.

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Summary of results
Overheating Analysis
Arthur Stanley House

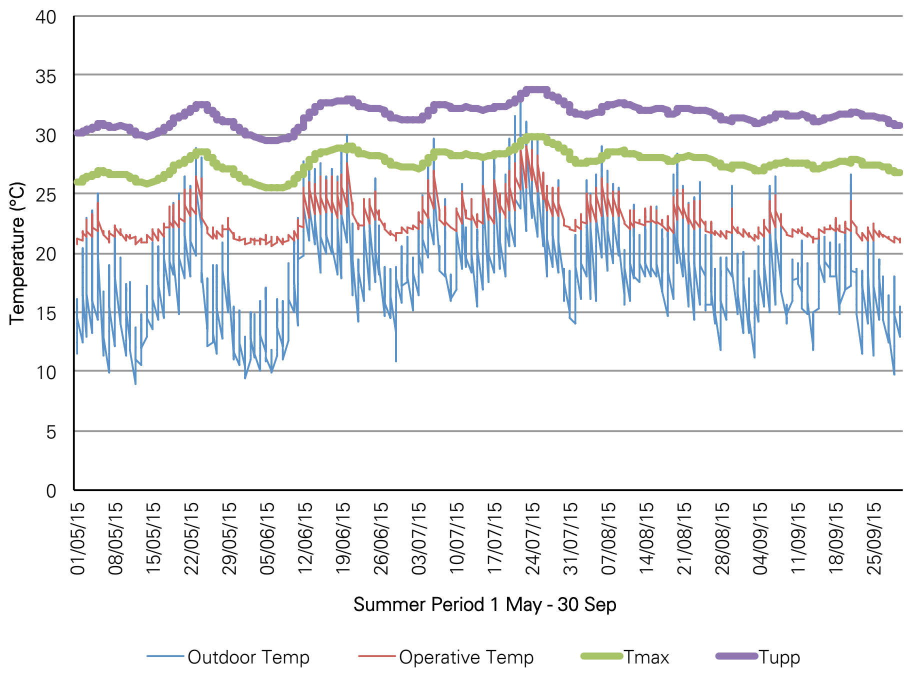
Overview of Results

In the graphs below, the outdoor and indoor temperatures of a typical living room and bedroom are presented. The graphs also show T_{max} and T_{upp}, which are the temperature of upper range of thermal comfort and the temperature of absolute upper limit of thermal comfort, respectively.

In order to comply with the overheating criteria the building must comply with two of the following three criteria (Criterion 1 to Criterion 3). All bedrooms should comply with criterion 4.

- Criterion 1 - The percentage of hours with a higher temperature than T_{max} should be less than 3%.
- Criterion 2 - The weighted exceedance shall be less than or equal to 6 in any one day.
- Criterion 3 - No occupied hours of the building shall exceed the absolute upper limit temperature. (T_{upp} = T_{max} + 4K).
- Criterion 4 - For bedrooms only: The operative temperature in bedrooms from 10 pm to 7 am shall not exceed 26°C for more than 1% of the hours

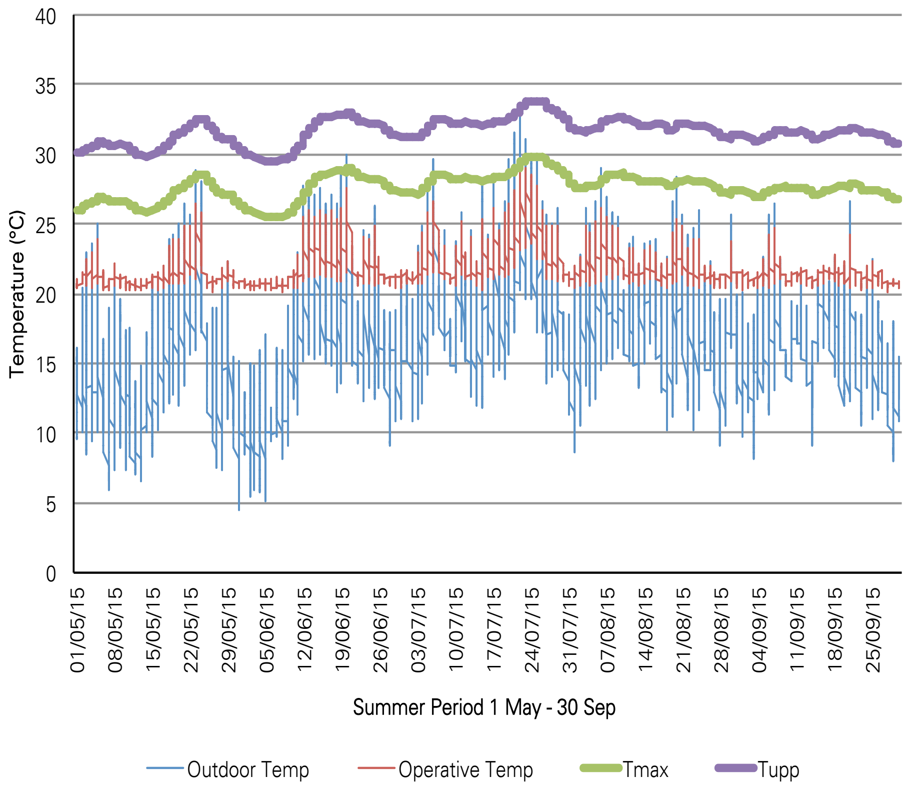
Duplex 1 – Living Room



Criterion 1	Criterion 2	Criterion 3	Criterion 4	Compliance
0.0	0.0	0.0	-	PASS

Summary of results
Overheating Analysis
Arthur Stanley House

Duplex 1 – Single Bedroom



Criterion 1	Criterion 2	Criterion 3	Criterion 4	Compliance
0.0	0.0	0.0	0.4	PASS

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Summary of results
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Summary of Results

Room	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Compliance
Duplex 1 – Ground Floor – Kitchen	0.1	1.0	0.0	-	PASS
Duplex 1 – Ground Floor – Living	0.0	0.0	0.0	-	PASS
Duplex 1 – Basement – Bedroom 1	0.0	0.0	0.0	0.2	PASS
Duplex 1 – Basement – Bedroom 2	0.0	0.0	0.0	0.2	PASS
Duplex 1 – Ground Floor – Single Bedroom	0.0	0.0	0.0	0.4	PASS
Duplex 1 – Ground Floor – Kitchen	0.2	2.0	0.0	-	PASS
Duplex 1 – Ground Floor – Living	0.0	0.0	0.0	-	PASS
Duplex 1 – Basement – Bedroom 1	0.0	0.0	0.0	0.2	PASS
Duplex 1 – Basement – Bedroom 2	0.0	0.0	0.0	0.3	PASS
Duplex 1 – Ground Floor – Single Bedroom	0.0	0.0	0.0	0.3	PASS

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Summary of results
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Explanation of Results

Criterion 1 shows that the scheme will experience temperatures above the thermal comfort T_{max} for less than 3%.

Criterion 2 shows that the maximum weighted exceedance does not exceed 6.

Criterion 3 shows that there are no hours above the absolute maximum daily temperature.

Criterion 4 shows that bedrooms will experience temperatures above 26°C for less than 1% (between 10pm to 7am).

Please note that according to CIBSE TM52, the space has to comply with at least two of the three criteria. According to CIBSE TM59, the dwelling should comply with both criterion 1 and criterion 4. Therefore, all assessed rooms comply with the overheating requirements.

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Conclusions
Overheating Analysis
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Conclusions

The proposal has responded to CIBSE TM52 and CIBSE TM59 requirements relating to overheating. The report has set out how the occupied spaces perform against strict thermal comfort standards for overheating. The scheme has implemented passive design measures and the modelling results indicate that the scheme is compliant with the overheating requirements.

The proposal maximises passive design measures by responding to the local context in the following ways:

- Energy efficiency lighting and appliances have been recommended to reduce internal heat gains;
- The building fabric will be insulated over and above the standards set out by Building Regulations, and the solar gains will be reduced with a glazing solar factor of 0.24, in order to keep the heat out of the building;
- Mechanical ventilation with heat recovery and summer bypass to provide fresh air and purge the heat out;
- Natural ventilation supply fresh air to the building through windows (as per ventilation rates section)

Note that the analysis was performed assuming that opening windows were controlled based on the level of occupancy and the operative indoor temperature of the space. To achieve the thermal comfort levels shown in this report the level of occupant control for the opening windows would need to be optimum i.e. fully responsive to indoor temperature.