MLM

Energy Statement

for

317 Finchely Road
London

produced for

317 Finchley Road Limited

www.mlm.uk.com

MLM Consulting Engineers Ltd
3rd Floor Eldon House, 2 Eldon Street, London, EC2M 7LS
Main Tel: 020 7422 7800

Project Revision Sheet

Revision No:	Date	Status	Changes	Author	Approved
01	20.01.2016	For Information	N/A	C Knabe-Nicol	G Carpenter
02	14.03.2016	For Planning	N/A	C Knabe-Nicol	G Carpenter
03	21.03.2016	For Planning	N/A	C Knabe-Nicol	G Carpenter
04	27.04.2016	For Planning	Number of Flats	C Knabe-Nicol	G Harden

Document Ref: GC/7133428/CKN
Revision: 04
Date: 27 April 2016

Prepared: Cyril Knabe-Nicol
Principal Building Energy Consultant

Contact Details: Tel: 0207 422 7800
Email: Cyril.knabe-nicol@mlm.uk.com

Checked: Grant Harden
Associate Director

Contents **Page**

Appendices

1 Introduction

MLM were commissioned to undertake an Energy Statement to accompany the planning application for the re-development of the site at 317 Finchley Road, Camden, London.

The development consists of the demolition of existing buildings and erection of 22 new build residential units and one commercial unit, associated landscaping and ancillary works.

The proposed development is located in the London Borough of Camden. The Greater London Authority and London Borough of Camden are the Regional and Local Bodies that set the Planning Policy Context, referencing to National Standards and Regulations.

The proposed development is required by the London Borough of Camden and the Greater London Authority to make carbon emission reductions in accordance with the London Plan's Energy Hierarchy and meet a 35% carbon emissions reduction over the current Building Regulations Part L2013 minimum requirements. The London Borough of Camden requires the development to achieve 20% carbon reduction by renewable energy on-site where feasible.

The aim of this report is to assess feasible carbon emissions reductions through the implementation of efficient energy measures, the use of an on-site Combined Heat and Power (CHP) system and finally the use of zero carbon technologies.

This report demonstrates how the design has followed the London Plan's Energy Hierarchy by reducing energy demand of the development. Measures proposed include passive design, energy efficiency measures, generating heat in a clean and efficient system and by using on-site renewable energy systems to further reduce the overall carbon emissions of the development.

The methodology applied follows the guidance set out by the Greater London Authority (GLA) for developing energy strategies as detailed in the London Plan: The Spatial Development Strategy for London consolidated with alterations since 2011 (March 2015).

The energy consumption figures for the proposed development are based on SAP modelling data produced under Building Regulations Part L1A 2013 software compliant for the residential part of the scheme. The energy consumption figures, for the communal part of the scheme are based on SBEM Benchmark in line with Building Regulations Part L2A 2013 Compliant Software.

The proposed Sustainability Principles and Engineering Concepts incorporate the requirements and guidelines of the relevant British Standards, CIBSE Guides and DfE Building Bulletins.

2 Executive Summary

The proposed development will implement significant energy efficiency measures, a Combined Heat and Power System and Air Source Heat Pumps system to achieve the required carbon emission reductions by the Local Authority and the London Plan. The strategy detailed within this report follows the Greater London Authority's Energy Hierarchy and achieves a 32.37% improvement in CO_2 emissions over Building Regulations 2013 minimum requirements.

The carbon emissions baseline for the scheme has been identified at 55,486kg CO_2/yr for space heating, domestic hot water, lighting and auxiliary (regulated emissions). To ensure Compliance with the Planning Requirements, the schemes needs to reduce its carbon emission by 19,420 kg CO_2/yr.

The following strategy has been implemented site wide:

- 'Be Lean': Energy efficiency measures to improve the building fabric and services includes: High performance U-Values (0.13 for external walls, 0.12 for roof, 0.12 for the ground floor, 0.00 for partition walls and 0.8 for windows (Triple glazed) in W/m^{2}K, good air tightness (maximum of 3m^3/m^2/hr at 50Pa).

- 'Be Clean': A CHP has been deemed feasible for the scheme and will provide approximately 60% of the heating and hot water demand.

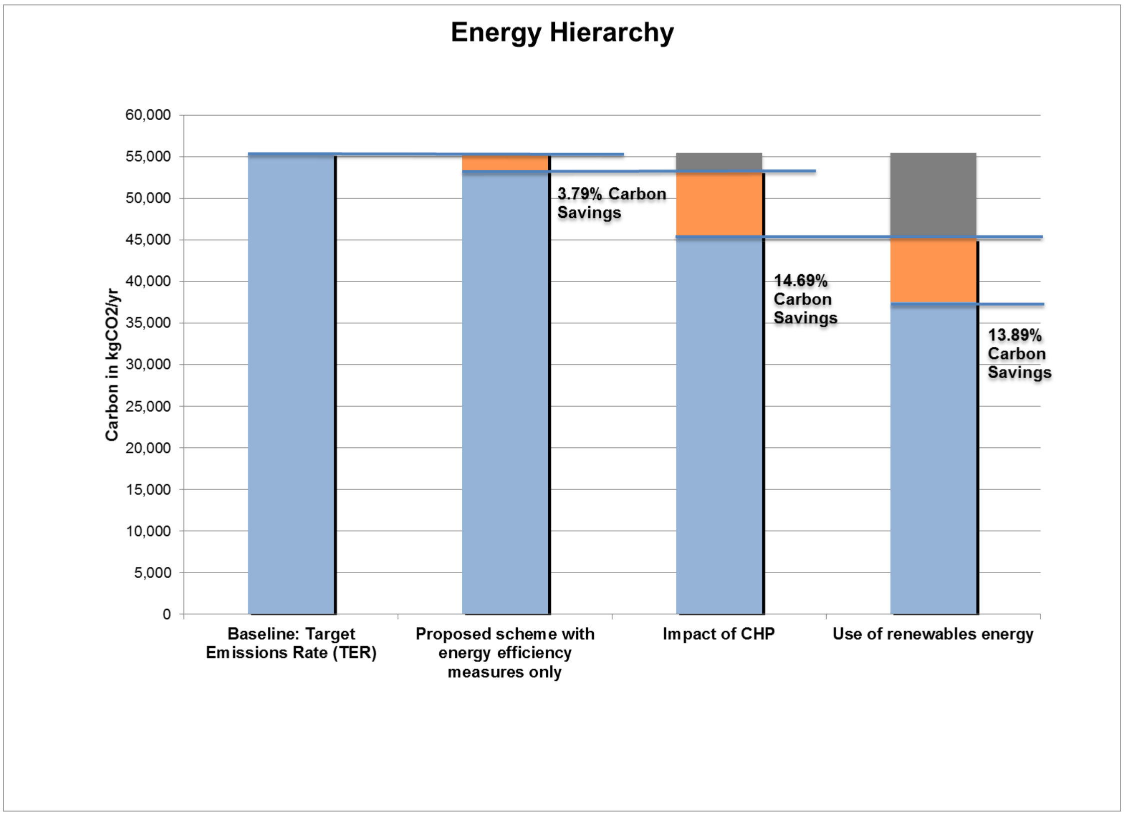
- 'Be Green': Air Source Heat Pumps system has been identified as suitable for the proposed scheme. Other zero carbon technologies are assessed within this report.

The energy efficiency measures included within this report represent current best practice and the use of a low and zero carbon technology.

The conclusions of the assessment can be summarised by the following table:

	Carbon Dioxide Emissions (Tonnes/ Annum)	**Incremental CO_2 Emissions Reduction (%)**	**Cumulative CO_2 Emissions Reduction (%)**
Step 1 – Baseline	55.486	-	-
Step 2 – 'Be Lean'	53.38	3.79	
Step 3 – 'Be Clean'	45.22	14.69	-
Step 4 – 'Be Green'	37.52	13.89	32.37

The following graph illustrates the carbon savings for each stage of the Greater London Authority's Energy Hierarchy against the previous stage.



3 Planning Requirement

This energy Assessment has been designed to adhere to the National, Regional and Local Policies. The proposed development is located within the Greater London area and is therefore requested to implement the London Plan Energy Hierarchy from GLA Energy Team Guidance on Planning Energy Assessments, Version 1, 2011, with amendment March 2015.

3.1 Baseline Model

The baseline has been taken from the Target Emission Rate (TER) worksheet of the SBEM and SAP Models. Following the London Plan Guidance, the baseline has been created with a gas boiler.

3.2 'Be Lean'

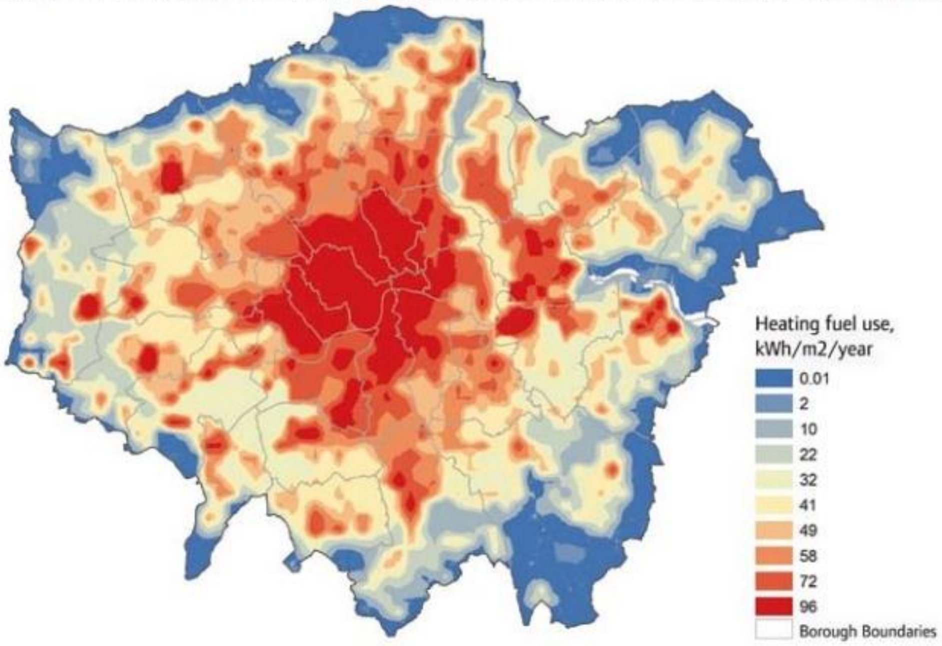
Implementation of energy efficient 'Be Lean' measures specific to the scheme is encouraged at the earliest Design Stage of a development and aims to reduce the energy demand. Measures typically include passive design: both Architectural and building fabric measures, and active design: energy efficient services. It is possible to exceed Building Regulations Requirements (Part L 2013) through reduced energy demand ('Be Lean') measures alone.

3.3 'Be Clean'

3.3.1 Decentralised Energy Networks Section

The GLA require developers to prioritise connection to existing or planned decentralised energy networks where feasible. The London heat map below has been developed to help Developers identify decentralised energy opportunities in London.

Map 5.1 Heat density in London (relative heat demand based on fuel use kWh/m2/year)



Source: Centre for Sustainable Energy. © Crown copyright. All rights reserved. Greater London Authority 100032379 (2009)

3.4 Decentralised Energy in Development Proposals Section 3.6

The use of the 'clean' energy supply refers to the energy efficiency of heating, cooling and power systems. Planning applications should demonstrate how the heating, cooling and power systems have been selected to minimise carbon emissions in accordance with the following hierarchy (Policy 5.6):

a The proposed development should evaluate the feasibility of the use of Combined Heat and Power (CHP) systems. Where a new CHP system is appropriate, opportunities to extend the system beyond the site boundary to adjacent sites should be examined.

b Major developments should select energy systems in accordance with the following hierarchy:

- Connection to existing heating or cooling networks;
- Site wide CHP network;
- Communal heating and cooling.

c Potential opportunities to meet the first priority in this hierarchy are outlined in the above London heat map. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Cooling

Where design measures and the use of natural and/or mechanical ventilation will not guarantee occupant comfort, a cooling strategy should be specified.

Where appropriate, the cooling strategy should investigate opportunities to improve efficiency through the use of locally available sources such as ground cooling, river/dock water cooling.

3.5 'Be Green' Section

The use of renewable energy in developments is encouraged at the 'Be Green' stage. Each renewable energy technology in Policy 5.7 of the London Plan are technically feasible in London and each should be considered in the Energy Statement.

All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets.

Figure 2 provides a graphical representation of the London Plan Energy Hierarchy.

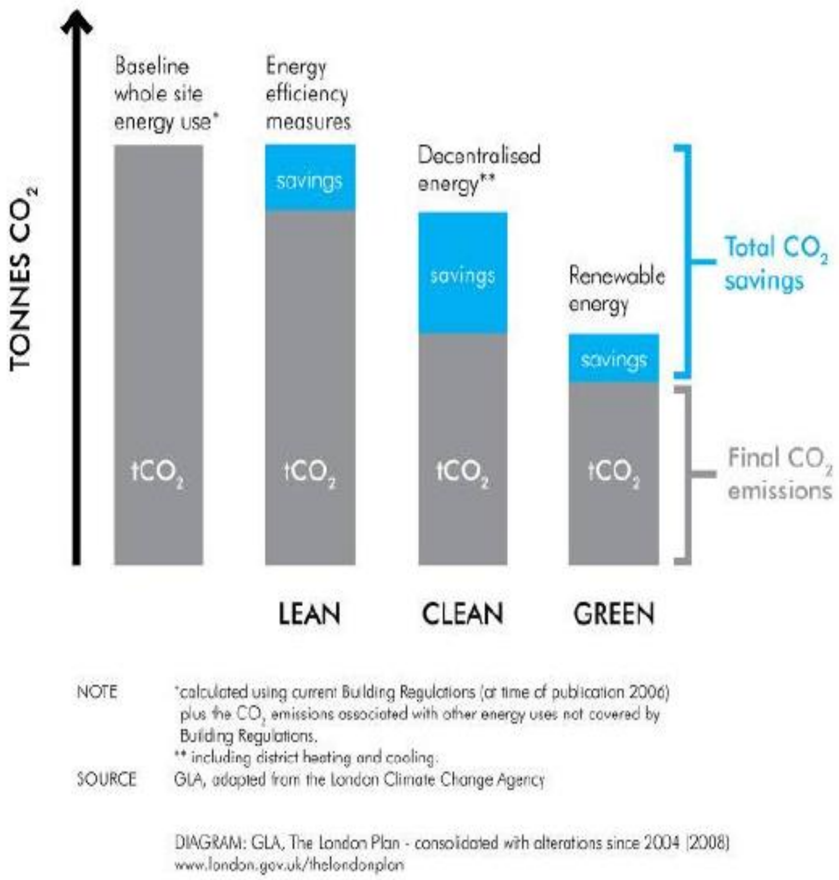


Figure 2 - Energy Hierarchy Diagram, London Plan

The sample Output Documents and Energy Reports can be found in Appendix A.

4 'Be Lean' Stage – Reduction by Energy Efficiency Measures

Specific energy efficient measures have been identified, reviewed and appraised for the proposed scheme. The sample Output Documents and Energy Reports can be found in Appendix B.

The measures outlined in this section result in an annual carbon emission saving of 3.28% which equate to 2,104kg CO_2/yr saved over the baseline.

4.1.1 Proposed Measures (Residential Part of the Development)

The following measures are applicable to the residential part of the scheme and allow the proposed development to comply with Building Regulation Part L1A 2013.

The energy efficiency measures include:

Passive

The development has been orientated to suit the site conditions.

Enhanced Building Fabric U-Values

Enhancements of the building fabric will be used.

The table below demonstrates the limiting U-Value set by Approved Document Part L and the proposed U-Value for the development.

Elements	Building Regulations Part L 1A 2013 minimum U-Value (W/m^{2}K)	Proposed U-Value (W/m^{2}K) Indicative Build-Up
External Walls	0.30	0.13
Party Walls	0.50	0.00
Floor	0.25	0.13
Roof	0.20	0.12
Windows (Triple Glazing)	2.00	0.80

Enhanced Air Tightness

The proposed development will be designed to high performance with good air tightness. It is proposed that the scheme not exceed an air permeability level of 3m^3/hr/m^2 at 50Pa during testing.

This target will be achieved by ensuring that sensitive areas are accounted for in the design and construction phases to make certain that a tightly sealed building is constructed and all punctures through the seal are air-tight. The Design Team must ensure that all opening both major and minor, such as services, be accounted for and assessed to reduce air leakage.

Thermal Junctions

Heat lost through thermal bridges has a significant impact on the performance of a building’s external envelope; this becomes ever more so as buildings become more airtight and more carefully insulated.

High-impact thermal bridges generally occur where two thermal elements meet (for example, the floor slab and perimeter wall), or where a thermal element is penetrated by a conductive material, such as steel or concrete. The heat loss through this junction is measured in W/m.K, and is known as a ‘ψ’ (psi) value; the average of these values is taken to provide the Y-Value, a figure which is ultimately entered into SAP software to measure the overall fabric energy efficiency.

The Design Team has agreed to mitigate the cold bridges and eliminate the potential for surface condensation; therefore, the average Y-Value targeted will be no more than 0.08W/mK.

Ventilation

The dwellings will be fitted with mechanical ventilation with heat recovery.

Dwelling Type	Efficiency	Specific Fan Power (W/l/s)
Kitchen + 1 Wet Room	94%	0.40
Kitchen + 2 Wet Rooms	94%	0.43
Kitchen + 3 Wet Rooms	94%	0.53
Kitchen + 4 Wet Rooms	93%	0.65

Heating

Space heating is to be supplied from a central heating system. The energy centre will include boiler and Combined Heat and Power Unit. Space heating will be distributed via an under floor heating systems.

The flues will be extended to roof level. Flue discharge will be in line with the Clean Air Act.

Cooling

Cooling will only be provided to the two penthouse apartments.

Domestic Hot Water

The domestic hot water will be provided by the main system.

Lighting

All lighting will be dedicated low energy fittings.

Lighting systems to a number of spaces may include LED technology where viable and subject to the performance of each product being able to deliver to the performance requirements of the space served.

4.1. 2 Proposed Measures (Commercial Part of the Development)

The following measures are applicable to the commercial part of the scheme and allow the proposed development to comply with Building Regulation Part L2A 2013.

The energy efficiency measures include:

Passive

The development has been orientated to maximise the benefit from solar gain.

Enhanced Building Fabric U-Values

Enhancements of the building fabric will be used, the table below demonstrates the limiting U-Values set by the Approved Document Part L and the proposed U-Value for the proposed development.

Elements	Building Regulations Part L 2A 2013 minimum U-Value (W/m^2K)	Proposed U-Value (W/m^2K) Indicative Build-Up
External Walls	0.35	0.13
Party Walls	0.50	0.00
Floor	0.25	0.13
Roof	0.25	0.12
Windows (Double Glazing)	2.20	1.4

Enhanced Air Tightness

The proposed development will be designed to high performance with good air tightness. It is proposed that the scheme does not exceed an air permeability level of $7m^3/hr/m^2$ at 50Pa during testing.

This target will be achieve by ensuring that sensitive areas are accounted for in the design and construction phases to make certain that a tightly sealed building is constructed and all punctures through the seal are air-tight.

The Design Team must ensure that all openings, both major and minor, such as services, be accounted for and assessed to reduce air leakage.

Ventilation

The ventilation has been assumed to have a specific fan power of 1.80W/l/s.

Heating/Cooling

Space heating and Cooling will be supplied by a split system. The condenser will be located outside at lower level.

Domestic Hot Water

The domestic hot water will be provided by instantaneous electric point of use water heaters.

Lighting

The lighting for the retail area and storage areas has been modelled at 85 luminaire lumens per circuit watt, tall other area will be at 70 lamp lumens per circuit watt.

5 'Be Clean' – Selection of Low Carbon Energy Supply Strategy

5.1 Connection to Existing Low Carbon Heating Infrastructure

The site is not located near an existing communal heating network.

5.2 Feasibility of CHP Scheme

It is possible to incorporate CHP (energy centre) into the scheme to meet the London Plan Hierarchy of providing 'clean' energy. The electricity generated will be harnessed directly by the development. Should the demand not be there at all times, excess electricity generated will be exported to the grid.

The CHP will be sized to deliver 60% of the annual energy demand of the development.

Flue arrangements for the CHP and boiler plant will be carefully considered and calculated against all relevant British Standard Criteria to ensure flue gases are dissipated above dwellings and buildings, both on the development site and any adjacent and in close proximity to the site.

Combined Heat and Power (CHP) – only applicable to the residential part of the development

Combined Heat and Power Generation (CHP) is an important technology for efficient fuel use and can use biomass or gas as the fuel source. The sample Output Documents and Energy Reports can be found in Appendix C.

A gas-fired CHP is regarded as a low carbon technology, not a true renewable. Should the supply of fuel to the CHP be biomass then the system can be considered as a true renewable system.

CHP primarily offers carbon emission reductions by reducing the amount of electricity imported from the national grid – a 'carbon heavy' source of electricity.

The system produces electricity that can be used in the building or exported to the grid, and heat for space, water and even process heating. Systems must be heat led for high efficiency, which best suits applications to situations where there is a significant demand for heat for long periods of time (particularly through the summer period). This will also apply to residential developments, hospitals, hotels and leisure centres (swimming pools being ideal).

The split of heat to power and losses in both types of CHP systems are slightly different, but in principal each unit of gas supplied would generate approx 35% electricity, 50% heat and 15% in losses.

CHP units operate most efficiently when supplying the base load of the building. Given the nature of the building (predominantly domestic) the base load will be on the lower side and with peaks and troughs throughout the occupied period; we are, therefore, proposing a base load of 60% of the annual energy demand.

6 'Be Green' – Renewable Technologies

6.1 Green Technologies

The following types of green/renewable energy technologies have been considered:

- Air Source Heat Pump.

Other renewable technology options were investigated and discounted.

These alternative technologies included:

- Solar Thermal;
- Photovoltaic Cells;
- Wind Turbines;
- Biomass Boiler;
- Ground Source Heat Pump.

The justification for discounting these technologies can be found in Appendix D.

6.2 Proposed Green Measures

Subject to the consideration of the technologies previously discussed, the following green measures will be incorporated into the proposed building to reduce fossil fuel consumption and mitigate carbon emissions:

6.2.1 Chosen Technology

Air Source Heat Pump (only applicable to the commercial part of the development)

A heat pump extracts heat from the ground, air or water and transfers it to a heating system. Often coupled to underfloor heating, as the temperatures involved are usually lower (around 40° where a boiler will be 80°), an electric pump circulates the water in the system. Ground source heat pumps (GSHP) and air source heat pumps (ASHP) are currently the most common type of heat pump used in the UK, and use technology which is essentially the same as a fridge. A typical GSHP system will include a ground heat exchanger (for extracting heat from the ground), the heat pump itself and a heating system.

The overall efficiency of a heat pump is determined by the difference in temperature between the heat source itself (the ground, air or water) and the temperature of the area or environment to be heated. The smaller the temperature difference the higher the coefficient of performance (COP) will be.

Typical COPs will be in the range two - four depending upon operating conditions. Heat pumps can supply 100% of heat demand, but it will usually only pre-heat domestic hot water, so an additional method of heating the hot water (e.g. an immersion heater) may be needed.

Units range in size but the smaller ones only require equipment approximately the size of a small air conditioning unit on the outside of the property.

Air source heat pumps can be connected in series and thus provide a heating system, modules only work as and when demand requires thus providing excellent efficiencies. The commercial unit will have its own system to reduce the number of units needed in order to serve this development and associated space.

7 Conclusion

This report has followed the London Plan: The Spatial Development Strategy for London consolidated with alterations since 2011 (March 2015) Strategy and Philosophy and in doing so has identified measures to improve energy efficiency and mitigate CO_2 emissions of the proposed development.

The following table provides a summary of the improvements recognised by each step of the energy hierarchy approach:

	Carbon Dioxide Emissions (Tonnes/ Annum)	Incremental CO_2 Emissions Reduction (%)	Cumulative CO_2 Emissions Reduction (%)
Step 1 – Baseline	55.486	-	-
Step 2 – 'Be Lean'	53.38	3.79	
Step 3 – 'Be Clean'	45.22	14.69	-
Step 4 – 'Be Green'	37.52	13.89	32.37

The use of on-site CHP unit with an overall efficiency of 96% and a heat to power ration of 2 will allow the development to achieve 14.69% carbon reduction against the 'Be Lean' stage. The incorporation of the air source heat pumps and systems will allow the development to achieve an overall carbon savings of 33.37% against Building Regulations Part L 2013. This will not exceed the required 35% reduction in emissions, as per the Local Authority Strategy and London Plan. The proposed development has enhanced the fabric and passive measures to high level and followed the London Plan energy hierarchy with the implementation of a combined heat and power unit. All renewable have been assessed and due to site constraint, the site is only suitable for air source heat pumps.

Appendix A - Step One - Baseline Output Document and Energy Report Figures

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.7	(1a) x	2.5	(2a) =	144.25	(3a)
First floor	45.67	(1b) x	2.5	(2b) =	114.17	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	103.37	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	258.42	(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) =	0.15	(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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

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

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

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

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

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

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

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

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

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

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	1	=	2.1			(26)
Windows Type 1			3.69	x1/[1/(1.4)+ 0.04]		=	4.89			(27)
Windows Type 2			4.83	x1/[1/(1.4)+ 0.04]		=	6.4			(27)
Windows Type 3			3.01	x1/[1/(1.4)+ 0.04]		=	3.99			(27)
Windows Type 4			5.01	x1/[1/(1.4)+ 0.04]		=	6.64			(27)
Floor			57.7	x	0.13	=	7.501			(28)
Walls Type1	54.06	8.52	45.54	x	0.18	=	8.2			(29)
Walls Type2	48.74	8.02	40.72	x	0.18	=	7.33			(29)
Total area of elements, m²			162.61							(31)
Party wall			44.05	x	0	=	0			(32)

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	47.06	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K	3.5	(36)

TER WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 50.56 (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=	49.46	49.2	48.94	47.72	47.49	46.43	46.43	46.23	46.84	47.49	47.95	48.43	(38)

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

(39)m=	100.02	99.75	99.49	98.27	98.05	96.98	96.98	96.79	97.39	98.05	98.51	98.99	

Average = $Sum(39)_{1...12}$ /12= 98.27 (39)

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

(40)m=	0.97	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.95	0.95	0.96

Average = $Sum(40)_{1...12}$ /12= 0.95 (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 2.77 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 99.95 (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=	109.95	105.95	101.95	97.96	93.96	89.96	89.96	93.96	97.96	101.95	105.95	109.95

Total = $Sum(44)_{1...12}$ = 1199.45 (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=	163.05	142.61	147.16	128.3	123.1	106.23	98.44	112.96	114.31	133.21	145.41	157.91

Total = $Sum(45)_{1...12}$ = 1572.67 (45)

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

(46)m=	24.46	21.39	22.07	19.24	18.47	15.93	14.77	16.94	17.15	19.98	21.81	23.69	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.75 (55)

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

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

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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=	209.65	184.69	193.75	173.39	169.7	151.32	145.03	159.55	159.4	179.81	190.5	204.5	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	209.65	184.69	193.75	173.39	169.7	151.32	145.03	159.55	159.4	179.81	190.5	204.5	

Output from water heater (annual)$_{1...12}$ | 2121.29 | (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=	91.49	81.09	86.21	78.73	78.21	71.39	70.01	74.83	74.08	81.57	84.42	89.78	(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=	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	(66)

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

(67)m=	24.34	21.62	17.58	13.31	9.95	8.4	9.08	11.8	15.83	20.1	23.46	25.01	(67)

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

(68)m=	261.66	264.38	257.54	242.97	224.58	207.3	195.76	193.04	199.88	214.45	232.84	250.12	(68)

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

(69)m=	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	(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=	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	(71)

Water heating gains (Table 5)

(72)m=	122.97	120.66	115.87	109.35	105.12	99.16	94.09	100.58	102.89	109.64	117.25	120.67	(72)

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

(73)m=	476.5	474.19	458.51	433.16	407.18	382.39	366.45	372.95	386.13	411.72	441.08	463.33	(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)	
North	0.9x	0.77	x	3.69	x	10.63	x	0.63	x	0.7	=	11.99	(74)
North	0.9x	0.77	x	4.83	x	10.63	x	0.63	x	0.7	=	15.7	(74)
North	0.9x	0.77	x	3.01	x	10.63	x	0.63	x	0.7	=	9.78	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.63	x	0.7	=	16.28	(74)
North	0.9x	0.77	x	3.69	x	20.32	x	0.63	x	0.7	=	22.92	(74)
North	0.9x	0.77	x	4.83	x	20.32	x	0.63	x	0.7	=	30	(74)
North	0.9x	0.77	x	3.01	x	20.32	x	0.63	x	0.7	=	18.69	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.63	x	0.7	=	31.11	(74)
North	0.9x	0.77	x	3.69	x	34.53	x	0.63	x	0.7	=	38.94	(74)
North	0.9x	0.77	x	4.83	x	34.53	x	0.63	x	0.7	=	50.97	(74)
North	0.9x	0.77	x	3.01	x	34.53	x	0.63	x	0.7	=	31.76	(74)
North	0.9x	0.77	x	5.01	x	34.53	x	0.63	x	0.7	=	52.87	(74)
North	0.9x	0.77	x	3.69	x	55.46	x	0.63	x	0.7	=	62.55	(74)
North	0.9x	0.77	x	4.83	x	55.46	x	0.63	x	0.7	=	81.87	(74)
North	0.9x	0.77	x	3.01	x	55.46	x	0.63	x	0.7	=	51.02	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.63	x	0.7	=	84.92	(74)
North	0.9x	0.77	x	3.69	x	74.72	x	0.63	x	0.7	=	84.26	(74)
North	0.9x	0.77	x	4.83	x	74.72	x	0.63	x	0.7	=	110.29	(74)
North	0.9x	0.77	x	3.01	x	74.72	x	0.63	x	0.7	=	68.73	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.63	x	0.7	=	114.4	(74)
North	0.9x	0.77	x	3.69	x	79.99	x	0.63	x	0.7	=	90.2	(74)
North	0.9x	0.77	x	4.83	x	79.99	x	0.63	x	0.7	=	118.07	(74)
North	0.9x	0.77	x	3.01	x	79.99	x	0.63	x	0.7	=	73.58	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.63	x	0.7	=	122.47	(74)
North	0.9x	0.77	x	3.69	x	74.68	x	0.63	x	0.7	=	84.21	(74)
North	0.9x	0.77	x	4.83	x	74.68	x	0.63	x	0.7	=	110.23	(74)
North	0.9x	0.77	x	3.01	x	74.68	x	0.63	x	0.7	=	68.69	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.63	x	0.7	=	114.34	(74)
North	0.9x	0.77	x	3.69	x	59.25	x	0.63	x	0.7	=	66.81	(74)
North	0.9x	0.77	x	4.83	x	59.25	x	0.63	x	0.7	=	87.45	(74)
North	0.9x	0.77	x	3.01	x	59.25	x	0.63	x	0.7	=	54.5	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.63	x	0.7	=	90.71	(74)
North	0.9x	0.77	x	3.69	x	41.52	x	0.63	x	0.7	=	46.82	(74)
North	0.9x	0.77	x	4.83	x	41.52	x	0.63	x	0.7	=	61.28	(74)
North	0.9x	0.77	x	3.01	x	41.52	x	0.63	x	0.7	=	38.19	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.63	x	0.7	=	63.57	(74)
North	0.9x	0.77	x	3.69	x	24.19	x	0.63	x	0.7	=	27.28	(74)
North	0.9x	0.77	x	4.83	x	24.19	x	0.63	x	0.7	=	35.71	(74)
North	0.9x	0.77	x	3.01	x	24.19	x	0.63	x	0.7	=	22.25	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	5.01	x	24.19	x	0.63	x	0.7	=	37.04	(74)
North	0.9x	0.77	x	3.69	x	13.12	x	0.63	x	0.7	=	14.79	(74)
North	0.9x	0.77	x	4.83	x	13.12	x	0.63	x	0.7	=	19.36	(74)
North	0.9x	0.77	x	3.01	x	13.12	x	0.63	x	0.7	=	12.07	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.63	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	3.69	x	8.86	x	0.63	x	0.7	=	10	(74)
North	0.9x	0.77	x	4.83	x	8.86	x	0.63	x	0.7	=	13.09	(74)
North	0.9x	0.77	x	3.01	x	8.86	x	0.63	x	0.7	=	8.15	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.63	x	0.7	=	13.57	(74)

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

(83)m=	53.75	102.72	174.54	280.36	377.68	404.31	377.48	299.48	209.86	122.27	66.31	44.81	(83)

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

(84)m=	530.25	576.91	633.06	713.52	784.85	786.7	743.93	672.43	595.99	533.99	507.39	508.14	(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	0.98	0.91	0.74	0.56	0.64	0.9	0.99	1	1	(86)

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

(87)m=	19.93	20.03	20.24	20.54	20.81	20.96	20.99	20.99	20.87	20.54	20.19	19.91	(87)

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

(88)m=	20.11	20.11	20.11	20.12	20.13	20.14	20.14	20.14	20.13	20.13	20.12	20.12	(88)

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

(89)m=	1	1	0.99	0.97	0.88	0.66	0.46	0.53	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=	18.66	18.82	19.11	19.56	19.93	20.11	20.13	20.13	20.02	19.56	19.05	18.65	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.03	19.17	19.44	19.84	20.19	20.36	20.38	20.38	20.27	19.85	19.38	19.02	(92)

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

(93)m=	19.03	19.17	19.44	19.84	20.19	20.36	20.38	20.38	20.27	19.85	19.38	19.02	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.97	0.88	0.68	0.49	0.56	0.86	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	529.33	575.08	627.82	690.56	689.61	535.1	364.19	379.2	511.82	523.97	505.57	507.46	(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=	1473.56	1423.59	1287.72	1075.59	832.58	558.48	367.02	385.33	600.8	906.62	1209.96	1466.66	(97)

TER WorkSheet: New dwelling design stage

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=	702.5	570.2	490.97	277.22	106.37	0	0	0	0	284.69	507.16	713.65		

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3652.77 (98)

Space heating requirement in kWh/m²/year 35.34 (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		93.5	(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)	702.5	570.2	490.97	277.22	106.37	0	0	0	0	284.69	507.16	713.65		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	751.34	609.84	525.1	296.49	113.77	0	0	0	0	304.48	542.42	763.26		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													3906.7	(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)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	209.65	184.69	193.75	173.39	169.7	151.32	145.03	159.55	159.4	179.81	190.5	204.5		
Efficiency of water heater													79.8	(216)
(217)m=	87.79	87.63	87.19	86.06	83.61	79.8	79.8	79.8	79.8	86.03	87.3	87.88		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.79	210.78	222.21	201.47	202.97	189.62	181.74	199.94	199.75	208.99	218.21	232.72		
Total = Sum(219a)$_{1...12}$ =													2507.2	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3906.7	
Water heating fuel used			2507.2	
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			429.8	(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	=	843.85	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	541.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1385.4	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	223.06	(268)
Total CO2, kg/year		sum of (265)…(271) =		1647.39	(272)

TER = 15.94 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.32	(1a) x	2.5	(2a) =	125.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.32	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.8	(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) =	0.16	(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		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(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

TER WorkSheet: New dwelling design stage

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

0.4	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	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	0.58	0.56	0.56	0.55	0.55	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	0.58	0.56	0.56	0.55	0.55	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			2.1	x	1	=	2.1			(26)
Windows Type 1			3.33	x1/[1/(1.4)+ 0.04]		=	4.41			(27)
Windows Type 2			5.01	x1/[1/(1.4)+ 0.04]		=	6.64			(27)
Walls	59.49	10.44	49.05	x	0.18	=	8.83			(29)
Total area of elements, m²			59.49							(31)
Party wall			17.5	x	0	=	0			(32)

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	21.99	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		4.7	(36)

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

Total fabric heat loss	(33) + (36) =	26.69	(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=	24.15	24.02	23.89	23.28	23.17	22.64	22.64	22.54	22.84	23.17	23.4	23.64	(38)

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

(39)m=	50.83	50.7	50.57	49.97	49.85	49.32	49.32	49.23	49.53	49.85	50.08	50.32	

Average = Sum(39)$_{1…12}$ /12= 49.97 (39)

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

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

Average = Sum(40)1…12 /12= 0.99 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (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=	82.02	79.04	76.06	73.07	70.09	67.11	67.11	70.09	73.07	76.06	79.04	82.02	
										Total = Sum(44)1…12 =		894.76	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	121.63	106.38	109.78	95.71	91.83	79.24	73.43	84.26	85.27	99.37	108.47	117.8	
										Total = Sum(45)1…12 =		1173.18	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.25	15.96	16.47	14.36	13.77	11.89	11.01	12.64	12.79	14.91	16.27	17.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.75 (55)

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

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

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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=	168.23	148.47	156.37	140.8	138.43	124.34	120.03	130.86	130.36	145.97	153.57	164.39	(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=	168.23	148.47	156.37	140.8	138.43	124.34	120.03	130.86	130.36	145.97	153.57	164.39	

Output from water heater (annual)$_{1…12}$ 1721.8 (64)

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

(65)m=	77.72	69.04	73.78	67.9	67.81	62.42	61.69	65.29	64.43	70.32	72.14	76.44	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)

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

(67)m=	13.68	12.15	9.88	7.48	5.59	4.72	5.1	6.63	8.9	11.3	13.19	14.06	(67)

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

(68)m=	148.07	149.6	145.73	137.49	127.08	117.3	110.77	109.23	113.11	121.35	131.75	141.53	(68)

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

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)

Water heating gains (Table 5)

(72)m=	104.46	102.74	99.16	94.3	91.14	86.7	82.92	87.76	89.48	94.51	100.2	102.75	(72)

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

(73)m=	317.7	315.98	306.26	290.76	275.31	260.21	250.28	255.12	262.98	278.65	296.63	309.83	(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)	
North	0.9x	0.77	x	3.33	x	10.63	x	0.63	x	0.7	=	10.82	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.63	x	0.7	=	16.28	(74)
North	0.9x	0.77	x	3.33	x	20.32	x	0.63	x	0.7	=	20.68	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.63	x	0.7	=	31.11	(74)
North	0.9x	0.77	x	3.33	x	34.53	x	0.63	x	0.7	=	35.14	(74)

North	0.9x	0.77	x	5.01	x	34.53	x	0.63	x	0.7	=	52.87	(74)
North	0.9x	0.77	x	3.33	x	55.46	x	0.63	x	0.7	=	56.45	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.63	x	0.7	=	84.92	(74)
North	0.9x	0.77	x	3.33	x	74.72	x	0.63	x	0.7	=	76.04	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.63	x	0.7	=	114.4	(74)
North	0.9x	0.77	x	3.33	x	79.99	x	0.63	x	0.7	=	81.4	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.63	x	0.7	=	122.47	(74)
North	0.9x	0.77	x	3.33	x	74.68	x	0.63	x	0.7	=	76	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.63	x	0.7	=	114.34	(74)
North	0.9x	0.77	x	3.33	x	59.25	x	0.63	x	0.7	=	60.29	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.63	x	0.7	=	90.71	(74)
North	0.9x	0.77	x	3.33	x	41.52	x	0.63	x	0.7	=	42.25	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.63	x	0.7	=	63.57	(74)
North	0.9x	0.77	x	3.33	x	24.19	x	0.63	x	0.7	=	24.62	(74)
North	0.9x	0.77	x	5.01	x	24.19	x	0.63	x	0.7	=	37.04	(74)
North	0.9x	0.77	x	3.33	x	13.12	x	0.63	x	0.7	=	13.35	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.63	x	0.7	=	20.08	(74)
North	0.9x	0.77	x	3.33	x	8.86	x	0.63	x	0.7	=	9.02	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.63	x	0.7	=	13.57	(74)

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

(83)m=	27.1	51.79	88.01	141.37	190.44	203.87	190.34	151.01	105.82	61.65	33.43	22.59	(83)

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

(84)m=	344.8	367.78	394.28	432.13	465.75	464.08	440.62	406.12	368.79	340.31	330.06	332.42	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.95	0.85	0.65	0.49	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=	20.03	20.14	20.34	20.63	20.87	20.98	21	20.99	20.92	20.64	20.29	20.01	(87)

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

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

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

(89)m=	0.99	0.99	0.98	0.94	0.8	0.57	0.39	0.45	0.75	0.95	0.99	1	(89)

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

(90)m=	18.79	18.94	19.24	19.65	19.96	20.08	20.1	20.1	20.03	19.67	19.18	18.77	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	19.39	19.52	19.77	20.12	20.4	20.51	20.53	20.53	20.46	20.13	19.71	19.37	(92)

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

TER WorkSheet: New dwelling design stage

(93)m=	19.39	19.52	19.77	20.12	20.4	20.51	20.53	20.53	20.46	20.13	19.71	19.37	(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	0.82	0.61	0.44	0.5	0.78	0.95	0.99	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	342.6	364.06	385.77	404.61	381.06	283.73	192.85	201.29	286.38	324.03	325.99	330.67	(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=	766.85	741.01	670.91	560.74	433.63	291.68	193.84	203.23	315.05	475.31	631.65	763.19	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	315.64	253.31	212.14	112.41	39.12	0	0	0	0	112.55	220.08	321.8	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1587.04 (98)

Space heating requirement in kWh/m²/year 31.54 (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		93.5	(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)														
	315.64	253.31	212.14	112.41	39.12	0	0	0	0	112.55	220.08	321.8		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	337.58	270.92	226.89	120.23	41.84	0	0	0	0	120.37	235.38	344.17		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1697.37	(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)														
	168.23	148.47	156.37	140.8	138.43	124.34	120.03	130.86	130.36	145.97	153.57	164.39		
Efficiency of water heater													79.8	(216)
(217)m=	86.47	86.23	85.63	84.22	81.93	79.8	79.8	79.8	79.8	84.13	85.77	86.57		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	194.55	172.18	182.62	167.18	168.95	155.81	150.41	163.98	163.36	173.5	179.04	189.88		
Total = Sum(219a)$_{1...12}$ =													2061.46	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1697.37

TER WorkSheet: New dwelling design stage

Water heating fuel used			2061.46	
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			241.56	(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	=	366.63	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	445.27	(264)
Space and water heating	(261) + (262) + (263) + (264) =			811.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	125.37	(268)
Total CO2, kg/year		sum of (265)…(271) =		976.2	(272)

TER = 19.4 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.88	(1a) x	2.5	(2a) =	167.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.2	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.37	0.36	0.35	0.32	0.31	0.27	0.27	0.26	0.29	0.31	0.32	0.34

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.56	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	0.56	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			2.1	x 1	= 2.1			(26)
Windows Type 1			5.7	x1/[1/(1.4)+ 0.04]	= 7.56			(27)
Windows Type 2			2.81	x1/[1/(1.4)+ 0.04]	= 3.73			(27)
Windows Type 3			6.11	x1/[1/(1.4)+ 0.04]	= 8.1			(27)
Walls	95.5	16.72	78.78	x 0.18	= 14.18			(29)
Total area of elements, m²			95.5					(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.66 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 2.25 (36)

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

Total fabric heat loss (33) + (36) = 37.91 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.27	31.13	30.99	30.33	30.2	29.63	29.63	29.52	29.85	30.2	30.45	30.71	(38)

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

(39)m=	69.18	69.04	68.9	68.24	68.12	67.54	67.54	67.44	67.76	68.12	68.37	68.63	

Average = $Sum(39)_{1…12}$ /12= 68.24 (39)

TER WorkSheet: New dwelling design stage

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

(40)m=	1.03	1.03	1.03	1.02	1.02	1.01	1.01	1.01	1.01	1.02	1.02	1.03

Average = Sum(40)$_{1…12}$ /12= 1.02 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.17 (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 85.69 (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=	94.26	90.83	87.41	83.98	80.55	77.12	77.12	80.55	83.98	87.41	90.83	94.26	
										Total = Sum(44)$_{1…12}$ =		1028.3	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	139.79	122.26	126.16	109.99	105.54	91.07	84.39	96.84	97.99	114.2	124.66	135.38	
										Total = Sum(45)$_{1…12}$ =		1348.26	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	20.97	18.34	18.92	16.5	15.83	13.66	12.66	14.53	14.7	17.13	18.7	20.31	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

Enter (50) or (54) in (55) 0.75 (55)

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

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

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

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

TER WorkSheet: New dwelling design stage

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

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

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=	186.38	164.34	172.75	155.08	152.13	136.16	130.98	143.43	143.09	160.8	169.75	181.97	(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=	186.38	164.34	172.75	155.08	152.13	136.16	130.98	143.43	143.09	160.8	169.75	181.97	

Output from water heater (annual)$_{1...12}$ 1896.88 (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=	83.75	74.32	79.22	72.64	72.37	66.35	65.34	69.47	68.66	75.25	77.52	82.29	(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=	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	(66)

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

(67)m=	17.35	15.41	12.53	9.49	7.09	5.99	6.47	8.41	11.29	14.33	16.73	17.83	(67)

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

(68)m=	189.91	191.88	186.91	176.34	163	150.45	142.07	140.1	145.07	155.64	168.99	181.53	(68)

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

(69)m=	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	(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=	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	(71)

Water heating gains (Table 5)

(72)m=	112.57	110.59	106.48	100.9	97.27	92.16	87.82	93.38	95.36	101.14	107.67	110.6	(72)

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

(73)m=	378.35	376.4	364.45	345.24	325.88	307.12	294.88	300.41	310.23	329.63	351.91	368.48	(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)	
East	0.9x	1	x	5.7	x	19.64	x	0.63	x	0.7	=	23.99	(76)
East	0.9x	1	x	5.7	x	38.42	x	0.63	x	0.7	=	46.94	(76)
East	0.9x	1	x	5.7	x	63.27	x	0.63	x	0.7	=	77.3	(76)
East	0.9x	1	x	5.7	x	92.28	x	0.63	x	0.7	=	112.73	(76)
East	0.9x	1	x	5.7	x	113.09	x	0.63	x	0.7	=	138.16	(76)

TER WorkSheet: New dwelling design stage

East	0.9x	1	x	5.7	x	115.77	x	0.63	x	0.7	=	141.43	(76)
East	0.9x	1	x	5.7	x	110.22	x	0.63	x	0.7	=	134.65	(76)
East	0.9x	1	x	5.7	x	94.68	x	0.63	x	0.7	=	115.66	(76)
East	0.9x	1	x	5.7	x	73.59	x	0.63	x	0.7	=	89.9	(76)
East	0.9x	1	x	5.7	x	45.59	x	0.63	x	0.7	=	55.69	(76)
East	0.9x	1	x	5.7	x	24.49	x	0.63	x	0.7	=	29.92	(76)
East	0.9x	1	x	5.7	x	16.15	x	0.63	x	0.7	=	19.73	(76)
South	0.9x	0.54	x	2.81	x	46.75	x	0.63	x	0.7	=	28.16	(78)
South	0.9x	0.54	x	2.81	x	76.57	x	0.63	x	0.7	=	46.11	(78)
South	0.9x	0.54	x	2.81	x	97.53	x	0.63	x	0.7	=	58.74	(78)
South	0.9x	0.54	x	2.81	x	110.23	x	0.63	x	0.7	=	66.39	(78)
South	0.9x	0.54	x	2.81	x	114.87	x	0.63	x	0.7	=	69.18	(78)
South	0.9x	0.54	x	2.81	x	110.55	x	0.63	x	0.7	=	66.58	(78)
South	0.9x	0.54	x	2.81	x	108.01	x	0.63	x	0.7	=	65.05	(78)
South	0.9x	0.54	x	2.81	x	104.89	x	0.63	x	0.7	=	63.17	(78)
South	0.9x	0.54	x	2.81	x	101.89	x	0.63	x	0.7	=	61.36	(78)
South	0.9x	0.54	x	2.81	x	82.59	x	0.63	x	0.7	=	49.74	(78)
South	0.9x	0.54	x	2.81	x	55.42	x	0.63	x	0.7	=	33.38	(78)
South	0.9x	0.54	x	2.81	x	40.4	x	0.63	x	0.7	=	24.33	(78)
West	0.9x	0.54	x	6.11	x	19.64	x	0.63	x	0.7	=	25.72	(80)
West	0.9x	0.54	x	6.11	x	38.42	x	0.63	x	0.7	=	50.31	(80)
West	0.9x	0.54	x	6.11	x	63.27	x	0.63	x	0.7	=	82.86	(80)
West	0.9x	0.54	x	6.11	x	92.28	x	0.63	x	0.7	=	120.84	(80)
West	0.9x	0.54	x	6.11	x	113.09	x	0.63	x	0.7	=	148.1	(80)
West	0.9x	0.54	x	6.11	x	115.77	x	0.63	x	0.7	=	151.61	(80)
West	0.9x	0.54	x	6.11	x	110.22	x	0.63	x	0.7	=	144.33	(80)
West	0.9x	0.54	x	6.11	x	94.68	x	0.63	x	0.7	=	123.98	(80)
West	0.9x	0.54	x	6.11	x	73.59	x	0.63	x	0.7	=	96.37	(80)
West	0.9x	0.54	x	6.11	x	45.59	x	0.63	x	0.7	=	59.7	(80)
West	0.9x	0.54	x	6.11	x	24.49	x	0.63	x	0.7	=	32.07	(80)
West	0.9x	0.54	x	6.11	x	16.15	x	0.63	x	0.7	=	21.15	(80)

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

(83)m=	77.87	143.36	218.9	299.97	355.44	359.62	344.03	302.82	247.63	165.13	95.36	65.21	(83)

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

(84)m=	456.22	519.77	583.35	645.21	681.32	666.74	638.91	603.23	557.86	494.77	447.27	433.69	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.81	0.63	0.46	0.51	0.76	0.95	0.99	1	(86)

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

(87)m=	19.99	20.14	20.38	20.68	20.89	20.98	21	20.99	20.94	20.66	20.27	19.96	(87)

Stroma FSAP 2012 Version: 1.0.1.24 (SAP 9.92) - http://www.stroma.com

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

(88)m=	20.05	20.06	20.06	20.07	20.07	20.08	20.08	20.08	20.07	20.07	20.06	20.06	(88)

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

(89)m=	1	0.99	0.97	0.91	0.76	0.55	0.37	0.41	0.69	0.93	0.99	1	(89)

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

(90)m=	18.72	18.94	19.28	19.7	19.96	20.06	20.07	20.07	20.03	19.68	19.13	18.68	(90)

fLA = Living area ÷ (4) = 0.56 (91)

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

(92)m=	19.43	19.61	19.9	20.24	20.48	20.58	20.59	20.59	20.54	20.23	19.77	19.4	(92)

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

(93)m=	19.43	19.61	19.9	20.24	20.48	20.58	20.59	20.59	20.54	20.23	19.77	19.4	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.91	0.79	0.59	0.42	0.46	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	453.48	513.25	565.19	588.93	536.28	393.62	268.32	280.4	406.15	464.56	441.59	431.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1046.98	1015.85	923.31	774.18	598.11	403.65	269.58	282.58	436.37	656.04	866.17	1043.15	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	441.56	337.74	266.44	133.38	46	0	0	0	0	142.46	305.7	454.93	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2128.22 (98)

Space heating requirement in kWh/m²/year 31.82 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	441.56	337.74	266.44	133.38	46	0	0	0	0	142.46	305.7	454.93	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	472.26	361.22	284.96	142.66	49.2	0	0	0	0	152.37	326.95	486.56	

Total (kWh/year) =$Sum(211)_{1...5,10...12}$= 2276.18 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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)

186.38	164.34	172.75	155.08	152.13	136.16	130.98	143.43	143.09	160.8	169.75	181.97

Efficiency of water heater | 79.8 | (216)

(217)m=	87.04	86.7	85.97	84.41	82.05	79.8	79.8	79.8	79.8	84.49	86.37	87.16	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	214.14	189.56	200.96	183.71	185.41	170.63	164.14	179.74	179.31	190.31	196.55	208.77

Total = Sum(219a)$_{1…12}$ = | 2263.24 | (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2276.18	
Water heating fuel used		2263.24	
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		306.38	(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	=	491.65	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	488.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =				980.51	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	159.01	(268)
Total CO2, kg/year			sum of (265)…(271) =		1178.45	(272)

TER = | 17.62 | (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.18	(1a) x	2.5	(2a) =	177.95	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.95	(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) =	0.17	(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 *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*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(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) =	0.32	(21)

Infiltration rate modified for monthly wind speed

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

TER WorkSheet: New dwelling design stage

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

0.41	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.32	0.35	0.36	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			2.1	x	1	=	2.1			(26)
Windows Type 1			5.4	x1/[1/(1.4)+ 0.04]		=	7.16			(27)
Windows Type 2			10.29	x1/[1/(1.4)+ 0.04]		=	13.64			(27)
Walls	91.8	17.79	74.01	x	0.18	=	13.32			(29)
Roof	71.18	0	71.18	x	0.13	=	9.25			(30)
Total area of elements, m²			162.98							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 45.48 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 19.05 (36)

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

Total fabric heat loss (33) + (36) = 64.53 (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=	34.38	34.19	34	33.1	32.93	32.15	32.15	32.01	32.45	32.93	33.27	33.63	(38)

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

(39)m=	98.91	98.72	98.52	97.63	97.46	96.68	96.68	96.53	96.98	97.46	97.8	98.15	

Average = $Sum(39)_{1...12}$ /12= 97.63 (39)

TER WorkSheet: New dwelling design stage

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

(40)m=	1.39	1.39	1.38	1.37	1.37	1.36	1.36	1.36	1.36	1.37	1.37	1.38

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.27 (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 — 88.22 (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=	97.04	93.51	89.98	86.45	82.92	79.4	79.4	82.92	86.45	89.98	93.51	97.04	

Total = Sum(44)$_{1...12}$ = 1058.61 (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=	143.91	125.86	129.88	113.23	108.65	93.75	86.88	99.69	100.88	117.57	128.34	139.37

Total = Sum(45)$_{1...12}$ = 1388.01 (45)

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

(46)m=	21.59	18.88	19.48	16.98	16.3	14.06	13.03	14.95	15.13	17.64	19.25	20.9	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 150 (47)

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.39 (48)

Temperature factor from Table 2b — 0.54 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 0.75 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0.75 (55)

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

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

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

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

TER WorkSheet: New dwelling design stage

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

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

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

(62)m=	190.5	167.95	176.47	158.32	155.24	138.85	133.47	146.29	145.98	164.17	173.43	185.96	(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=	190.5	167.95	176.47	158.32	155.24	138.85	133.47	146.29	145.98	164.17	173.43	185.96	

Output from water heater (annual)$_{1...12}$ 1936.62 (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=	85.12	75.52	80.46	73.72	73.4	67.25	66.16	70.42	69.62	76.37	78.75	83.62	(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=	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	(66)

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

(67)m=	18.25	16.21	13.18	9.98	7.46	6.3	6.8	8.85	11.87	15.07	17.59	18.76	(67)

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

(68)m=	200.04	202.11	196.88	185.74	171.69	158.48	149.65	147.57	152.81	163.94	178	191.21	(68)

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

(69)m=	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	(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=	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	(71)

Water heating gains (Table 5)

(72)m=	114.42	112.38	108.15	102.39	98.66	93.4	88.93	94.66	96.69	102.65	109.37	112.39	(72)

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

(73)m=	392.82	390.81	378.32	358.23	337.92	318.29	305.5	311.19	321.48	341.78	365.08	382.47	(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)	
North	0.9x	0.54	x	10.29	x	10.63	x	0.63	x	0.7	=	23.45	(74)
North	0.9x	0.54	x	10.29	x	20.32	x	0.63	x	0.7	=	44.82	(74)
North	0.9x	0.54	x	10.29	x	34.53	x	0.63	x	0.7	=	76.15	(74)
North	0.9x	0.54	x	10.29	x	55.46	x	0.63	x	0.7	=	122.32	(74)
North	0.9x	0.54	x	10.29	x	74.72	x	0.63	x	0.7	=	164.78	(74)

TER WorkSheet: New dwelling design stage

North	0.9x	0.54	x	10.29	x	79.99	x	0.63	x	0.7	=	176.4	(74)
North	0.9x	0.54	x	10.29	x	74.68	x	0.63	x	0.7	=	164.69	(74)
North	0.9x	0.54	x	10.29	x	59.25	x	0.63	x	0.7	=	130.66	(74)
North	0.9x	0.54	x	10.29	x	41.52	x	0.63	x	0.7	=	91.56	(74)
North	0.9x	0.54	x	10.29	x	24.19	x	0.63	x	0.7	=	53.35	(74)
North	0.9x	0.54	x	10.29	x	13.12	x	0.63	x	0.7	=	28.93	(74)
North	0.9x	0.54	x	10.29	x	8.86	x	0.63	x	0.7	=	19.55	(74)
West	0.9x	0.54	x	5.4	x	19.64	x	0.63	x	0.7	=	22.73	(80)
West	0.9x	0.54	x	5.4	x	38.42	x	0.63	x	0.7	=	44.47	(80)
West	0.9x	0.54	x	5.4	x	63.27	x	0.63	x	0.7	=	73.23	(80)
West	0.9x	0.54	x	5.4	x	92.28	x	0.63	x	0.7	=	106.8	(80)
West	0.9x	0.54	x	5.4	x	113.09	x	0.63	x	0.7	=	130.89	(80)
West	0.9x	0.54	x	5.4	x	115.77	x	0.63	x	0.7	=	133.99	(80)
West	0.9x	0.54	x	5.4	x	110.22	x	0.63	x	0.7	=	127.56	(80)
West	0.9x	0.54	x	5.4	x	94.68	x	0.63	x	0.7	=	109.57	(80)
West	0.9x	0.54	x	5.4	x	73.59	x	0.63	x	0.7	=	85.17	(80)
West	0.9x	0.54	x	5.4	x	45.59	x	0.63	x	0.7	=	52.76	(80)
West	0.9x	0.54	x	5.4	x	24.49	x	0.63	x	0.7	=	28.34	(80)
West	0.9x	0.54	x	5.4	x	16.15	x	0.63	x	0.7	=	18.69	(80)

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

(83)m=	46.18	89.28	149.38	229.12	295.67	310.39	292.25	240.24	176.73	106.11	57.27	38.24	(83)

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

(84)m=	439	480.1	527.71	587.36	633.59	628.68	597.75	551.43	498.21	447.89	422.35	420.71	(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	0.81	0.66	0.72	0.91	0.98	1	1	(86)

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

(87)m=	19.47	19.59	19.85	20.23	20.59	20.86	20.96	20.94	20.73	20.27	19.81	19.44	(87)

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

(88)m=	19.77	19.77	19.78	19.79	19.79	19.8	19.8	19.8	19.79	19.79	19.78	19.78	(88)

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

(89)m=	1	0.99	0.99	0.97	0.89	0.71	0.5	0.57	0.85	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=	17.75	17.94	18.32	18.86	19.37	19.7	19.78	19.77	19.56	18.94	18.26	17.72	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	18.32	18.49	18.83	19.32	19.78	20.08	20.17	20.16	19.95	19.38	18.77	18.29	(92)

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

(93)m=	18.32	18.49	18.83	19.32	19.78	20.08	20.17	20.16	19.95	19.38	18.77	18.29	(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	0.89	0.74	0.55	0.62	0.86	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	436.93	476.51	519.64	563.65	564.28	465.01	331.58	340.98	430.07	434.97	418.88	419.07	(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=	1386.55	1341.36	1214.62	1017	787.23	530.02	345.26	362.8	566.88	855.62	1141.74	1383.27	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	706.52	581.18	517.07	326.41	165.88	0	0	0	0	312.96	520.46	717.36	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3847.83 (98)

Space heating requirement in kWh/m²/year 54.06 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(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)														
	706.52	581.18	517.07	326.41	165.88	0	0	0	0	312.96	520.46	717.36		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	755.63	621.58	553.01	349.1	177.41	0	0	0	0	334.72	556.64	767.23		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4115.33	(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)														
	190.5	167.95	176.47	158.32	155.24	138.85	133.47	146.29	145.98	164.17	173.43	185.96		
Efficiency of water heater													79.8	(216)
(217)m=	87.99	87.86	87.51	86.7	84.99	79.8	79.8	79.8	79.8	86.51	87.57	88.07		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	216.49	191.16	201.65	182.6	182.66	173.99	167.26	183.32	182.93	189.77	198.06	211.15		
Total = Sum(219a)$_{1...12}$ =													2281.04	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		4115.33

TER WorkSheet: New dwelling design stage

Water heating fuel used			2281.04	
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			322.27	(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	=	888.91	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	492.7	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1381.61	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	167.26	(268)
Total CO2, kg/year		sum of (265)…(271) =		1587.8	(272)

TER = 22.31 (273)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	42.57	(1a)	x	2.5	(2a)	=	106.42	(3a)
First floor	32.51	(1b)	x	2.5	(2b)	=	81.27	(3b)
Second floor	31.06	(1c)	x	2.5	(2c)	=	77.65	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	106.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	265.35	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (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		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

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

0.43	0.43	0.42	0.37	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.4

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	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	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			2.1	x	1	=	2.1			(26)
Windows Type 1			2.23	x1/[1/(1.4)+ 0.04]		=	2.96			(27)
Windows Type 2			3.44	x1/[1/(1.4)+ 0.04]		=	4.56			(27)
Windows Type 3			3.53	x1/[1/(1.4)+ 0.04]		=	4.68			(27)
Windows Type 4			2.08	x1/[1/(1.4)+ 0.04]		=	2.76			(27)
Windows Type 5			3.44	x1/[1/(1.4)+ 0.04]		=	4.56			(27)
Windows Type 6			2.34	x1/[1/(1.4)+ 0.04]		=	3.1			(27)
Windows Type 7			1.89	x1/[1/(1.4)+ 0.04]		=	2.51			(27)
Windows Type 8			2	x1/[1/(1.4)+ 0.04]		=	2.65			(27)
Windows Type 9			1.46	x1/[1/(1.4)+ 0.04]		=	1.94			(27)
Windows Type 10			2.02	x1/[1/(1.4)+ 0.04]		=	2.68			(27)
Walls Type1	40.22	9.2	31.02	x	0.18	=	5.58			(29)
Walls Type2	39.17	7.86	31.31	x	0.18	=	5.64			(29)
Walls Type3	39.17	7.37	31.8	x	0.18	=	5.72			(29)
Roof	31.06	0	31.06	x	0.13	=	4.04			(30)
Total area of elements, m²			151.71							(31)
Party wall			63.1	x	0	=	0			(32)

TER WorkSheet: New dwelling design stage

** 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) = 55.47 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 19.05 (36)

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

Total fabric heat loss (33) + (36) = 74.52 (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=	52.04	51.72	51.41	49.93	49.65	48.37	48.37	48.13	48.86	49.65	50.21	50.8	(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=	126.56	126.24	125.92	124.45	124.17	122.89	122.89	122.65	123.38	124.17	124.73	125.32

Average = $Sum(39)_{1…12}$ /12= 124.45 (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=	1.19	1.19	1.19	1.17	1.17	1.16	1.16	1.16	1.16	1.17	1.18	1.18

Average = $Sum(40)_{1…12}$ /12= 1.17 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.79 (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) + 36 100.45 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more 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=	110.5	106.48	102.46	98.44	94.42	90.41	90.41	94.42	98.44	102.46	106.48	110.5

Total = $Sum(44)_{1…12}$ = 1205.42 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	163.86	143.32	147.89	128.93	123.72	106.76	98.93	113.52	114.87	133.88	146.14	158.69

Total = $Sum(45)_{1…12}$ = 1580.5 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.58	21.5	22.18	19.34	18.56	16.01	14.84	17.03	17.23	20.08	21.92	23.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)
Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)
Water storage loss:
a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)
Temperature factor from Table 2b 0.54 (49)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0.75	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0.75	(55)

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

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

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

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (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=	210.46	185.4	194.48	174.03	170.31	151.85	145.52	160.11	159.97	180.47	191.23	205.29	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	210.46	185.4	194.48	174.03	170.31	151.85	145.52	160.11	159.97	180.47	191.23	205.29	

Output from water heater (annual)$_{1\ldots12}$ — 2129.12 (64)

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

(65)m=	91.76	81.32	86.45	78.94	78.41	71.57	70.17	75.02	74.27	81.79	84.66	90.04	(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=	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	(66)

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

(67)m=	24.09	21.4	17.4	13.18	9.85	8.31	8.98	11.68	15.67	19.9	23.23	24.76	(67)

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

(68)m=	265.89	268.65	261.7	246.89	228.21	210.65	198.92	196.16	203.11	217.91	236.6	254.16	(68)

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

(69)m=	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	(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=	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	(71)

Water heating gains (Table 5)

(72)m=	123.33	121.01	116.2	109.64	105.39	99.4	94.31	100.83	103.15	109.93	117.59	121.02	(72)

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

(73)m=	481.16	478.91	463.14	437.56	411.29	386.21	370.06	376.51	389.78	415.59	445.26	467.79	(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)	
East	0.9x	1	x	2.23	x	19.64	x	0.63	x	0.7	=	9.39	(76)
East	0.9x	1	x	3.53	x	19.64	x	0.63	x	0.7	=	14.86	(76)
East	0.9x	1	x	2.34	x	19.64	x	0.63	x	0.7	=	9.85	(76)
East	0.9x	1	x	2.02	x	19.64	x	0.63	x	0.7	=	8.5	(76)
East	0.9x	1	x	2.23	x	38.42	x	0.63	x	0.7	=	18.36	(76)
East	0.9x	1	x	3.53	x	38.42	x	0.63	x	0.7	=	29.07	(76)
East	0.9x	1	x	2.34	x	38.42	x	0.63	x	0.7	=	19.27	(76)
East	0.9x	1	x	2.02	x	38.42	x	0.63	x	0.7	=	16.63	(76)
East	0.9x	1	x	2.23	x	63.27	x	0.63	x	0.7	=	30.24	(76)
East	0.9x	1	x	3.53	x	63.27	x	0.63	x	0.7	=	47.87	(76)
East	0.9x	1	x	2.34	x	63.27	x	0.63	x	0.7	=	31.73	(76)
East	0.9x	1	x	2.02	x	63.27	x	0.63	x	0.7	=	27.39	(76)
East	0.9x	1	x	2.23	x	92.28	x	0.63	x	0.7	=	44.1	(76)
East	0.9x	1	x	3.53	x	92.28	x	0.63	x	0.7	=	69.82	(76)
East	0.9x	1	x	2.34	x	92.28	x	0.63	x	0.7	=	46.28	(76)
East	0.9x	1	x	2.02	x	92.28	x	0.63	x	0.7	=	39.95	(76)
East	0.9x	1	x	2.23	x	113.09	x	0.63	x	0.7	=	54.05	(76)
East	0.9x	1	x	3.53	x	113.09	x	0.63	x	0.7	=	85.56	(76)
East	0.9x	1	x	2.34	x	113.09	x	0.63	x	0.7	=	56.72	(76)
East	0.9x	1	x	2.02	x	113.09	x	0.63	x	0.7	=	48.96	(76)
East	0.9x	1	x	2.23	x	115.77	x	0.63	x	0.7	=	55.33	(76)
East	0.9x	1	x	3.53	x	115.77	x	0.63	x	0.7	=	87.59	(76)
East	0.9x	1	x	2.34	x	115.77	x	0.63	x	0.7	=	58.06	(76)
East	0.9x	1	x	2.02	x	115.77	x	0.63	x	0.7	=	50.12	(76)
East	0.9x	1	x	2.23	x	110.22	x	0.63	x	0.7	=	52.68	(76)
East	0.9x	1	x	3.53	x	110.22	x	0.63	x	0.7	=	83.39	(76)
East	0.9x	1	x	2.34	x	110.22	x	0.63	x	0.7	=	55.28	(76)
East	0.9x	1	x	2.02	x	110.22	x	0.63	x	0.7	=	47.72	(76)
East	0.9x	1	x	2.23	x	94.68	x	0.63	x	0.7	=	45.25	(76)
East	0.9x	1	x	3.53	x	94.68	x	0.63	x	0.7	=	71.63	(76)
East	0.9x	1	x	2.34	x	94.68	x	0.63	x	0.7	=	47.48	(76)
East	0.9x	1	x	2.02	x	94.68	x	0.63	x	0.7	=	40.99	(76)

TER WorkSheet: New dwelling design stage

East	0.9x	1	x	2.23	x	73.59	x	0.63	x	0.7	=	35.17	(76)
East	0.9x	1	x	3.53	x	73.59	x	0.63	x	0.7	=	55.68	(76)
East	0.9x	1	x	2.34	x	73.59	x	0.63	x	0.7	=	36.91	(76)
East	0.9x	1	x	2.02	x	73.59	x	0.63	x	0.7	=	31.86	(76)
East	0.9x	1	x	2.23	x	45.59	x	0.63	x	0.7	=	21.79	(76)
East	0.9x	1	x	3.53	x	45.59	x	0.63	x	0.7	=	34.49	(76)
East	0.9x	1	x	2.34	x	45.59	x	0.63	x	0.7	=	22.86	(76)
East	0.9x	1	x	2.02	x	45.59	x	0.63	x	0.7	=	19.74	(76)
East	0.9x	1	x	2.23	x	24.49	x	0.63	x	0.7	=	11.7	(76)
East	0.9x	1	x	3.53	x	24.49	x	0.63	x	0.7	=	18.53	(76)
East	0.9x	1	x	2.34	x	24.49	x	0.63	x	0.7	=	12.28	(76)
East	0.9x	1	x	2.02	x	24.49	x	0.63	x	0.7	=	10.6	(76)
East	0.9x	1	x	2.23	x	16.15	x	0.63	x	0.7	=	7.72	(76)
East	0.9x	1	x	3.53	x	16.15	x	0.63	x	0.7	=	12.22	(76)
East	0.9x	1	x	2.34	x	16.15	x	0.63	x	0.7	=	8.1	(76)
East	0.9x	1	x	2.02	x	16.15	x	0.63	x	0.7	=	6.99	(76)
South	0.9x	0.54	x	3.44	x	46.75	x	0.63	x	0.7	=	34.47	(78)
South	0.9x	0.54	x	3.44	x	46.75	x	0.63	x	0.7	=	34.47	(78)
South	0.9x	0.54	x	2	x	46.75	x	0.63	x	0.7	=	20.04	(78)
South	0.9x	0.54	x	1.46	x	46.75	x	0.63	x	0.7	=	14.63	(78)
South	0.9x	0.54	x	3.44	x	76.57	x	0.63	x	0.7	=	56.45	(78)
South	0.9x	0.54	x	3.44	x	76.57	x	0.63	x	0.7	=	56.45	(78)
South	0.9x	0.54	x	2	x	76.57	x	0.63	x	0.7	=	32.82	(78)
South	0.9x	0.54	x	1.46	x	76.57	x	0.63	x	0.7	=	23.96	(78)
South	0.9x	0.54	x	3.44	x	97.53	x	0.63	x	0.7	=	71.91	(78)
South	0.9x	0.54	x	3.44	x	97.53	x	0.63	x	0.7	=	71.91	(78)
South	0.9x	0.54	x	2	x	97.53	x	0.63	x	0.7	=	41.81	(78)
South	0.9x	0.54	x	1.46	x	97.53	x	0.63	x	0.7	=	30.52	(78)
South	0.9x	0.54	x	3.44	x	110.23	x	0.63	x	0.7	=	81.27	(78)
South	0.9x	0.54	x	3.44	x	110.23	x	0.63	x	0.7	=	81.27	(78)
South	0.9x	0.54	x	2	x	110.23	x	0.63	x	0.7	=	47.25	(78)
South	0.9x	0.54	x	1.46	x	110.23	x	0.63	x	0.7	=	34.49	(78)
South	0.9x	0.54	x	3.44	x	114.87	x	0.63	x	0.7	=	84.69	(78)
South	0.9x	0.54	x	3.44	x	114.87	x	0.63	x	0.7	=	84.69	(78)
South	0.9x	0.54	x	2	x	114.87	x	0.63	x	0.7	=	49.24	(78)
South	0.9x	0.54	x	1.46	x	114.87	x	0.63	x	0.7	=	35.95	(78)
South	0.9x	0.54	x	3.44	x	110.55	x	0.63	x	0.7	=	81.5	(78)
South	0.9x	0.54	x	3.44	x	110.55	x	0.63	x	0.7	=	81.5	(78)
South	0.9x	0.54	x	2	x	110.55	x	0.63	x	0.7	=	47.39	(78)
South	0.9x	0.54	x	1.46	x	110.55	x	0.63	x	0.7	=	34.59	(78)
South	0.9x	0.54	x	3.44	x	108.01	x	0.63	x	0.7	=	79.64	(78)

South	0.9x	0.54	x	3.44	x	108.01	x	0.63	x	0.7	=	79.64	(78)
South	0.9x	0.54	x	2	x	108.01	x	0.63	x	0.7	=	46.3	(78)
South	0.9x	0.54	x	1.46	x	108.01	x	0.63	x	0.7	=	33.8	(78)
South	0.9x	0.54	x	3.44	x	104.89	x	0.63	x	0.7	=	77.34	(78)
South	0.9x	0.54	x	3.44	x	104.89	x	0.63	x	0.7	=	77.34	(78)
South	0.9x	0.54	x	2	x	104.89	x	0.63	x	0.7	=	44.96	(78)
South	0.9x	0.54	x	1.46	x	104.89	x	0.63	x	0.7	=	32.82	(78)
South	0.9x	0.54	x	3.44	x	101.89	x	0.63	x	0.7	=	75.12	(78)
South	0.9x	0.54	x	3.44	x	101.89	x	0.63	x	0.7	=	75.12	(78)
South	0.9x	0.54	x	2	x	101.89	x	0.63	x	0.7	=	43.67	(78)
South	0.9x	0.54	x	1.46	x	101.89	x	0.63	x	0.7	=	31.88	(78)
South	0.9x	0.54	x	3.44	x	82.59	x	0.63	x	0.7	=	60.89	(78)
South	0.9x	0.54	x	3.44	x	82.59	x	0.63	x	0.7	=	60.89	(78)
South	0.9x	0.54	x	2	x	82.59	x	0.63	x	0.7	=	35.4	(78)
South	0.9x	0.54	x	1.46	x	82.59	x	0.63	x	0.7	=	25.84	(78)
South	0.9x	0.54	x	3.44	x	55.42	x	0.63	x	0.7	=	40.86	(78)
South	0.9x	0.54	x	3.44	x	55.42	x	0.63	x	0.7	=	40.86	(78)
South	0.9x	0.54	x	2	x	55.42	x	0.63	x	0.7	=	23.75	(78)
South	0.9x	0.54	x	1.46	x	55.42	x	0.63	x	0.7	=	17.34	(78)
South	0.9x	0.54	x	3.44	x	40.4	x	0.63	x	0.7	=	29.78	(78)
South	0.9x	0.54	x	3.44	x	40.4	x	0.63	x	0.7	=	29.78	(78)
South	0.9x	0.54	x	2	x	40.4	x	0.63	x	0.7	=	17.32	(78)
South	0.9x	0.54	x	1.46	x	40.4	x	0.63	x	0.7	=	12.64	(78)
West	0.9x	0.54	x	2.08	x	19.64	x	0.63	x	0.7	=	8.76	(80)
West	0.9x	0.54	x	1.89	x	19.64	x	0.63	x	0.7	=	7.96	(80)
West	0.9x	0.54	x	2.08	x	38.42	x	0.63	x	0.7	=	17.13	(80)
West	0.9x	0.54	x	1.89	x	38.42	x	0.63	x	0.7	=	15.56	(80)
West	0.9x	0.54	x	2.08	x	63.27	x	0.63	x	0.7	=	28.21	(80)
West	0.9x	0.54	x	1.89	x	63.27	x	0.63	x	0.7	=	25.63	(80)
West	0.9x	0.54	x	2.08	x	92.28	x	0.63	x	0.7	=	41.14	(80)
West	0.9x	0.54	x	1.89	x	92.28	x	0.63	x	0.7	=	37.38	(80)
West	0.9x	0.54	x	2.08	x	113.09	x	0.63	x	0.7	=	50.42	(80)
West	0.9x	0.54	x	1.89	x	113.09	x	0.63	x	0.7	=	45.81	(80)
West	0.9x	0.54	x	2.08	x	115.77	x	0.63	x	0.7	=	51.61	(80)
West	0.9x	0.54	x	1.89	x	115.77	x	0.63	x	0.7	=	46.9	(80)
West	0.9x	0.54	x	2.08	x	110.22	x	0.63	x	0.7	=	49.14	(80)
West	0.9x	0.54	x	1.89	x	110.22	x	0.63	x	0.7	=	44.65	(80)
West	0.9x	0.54	x	2.08	x	94.68	x	0.63	x	0.7	=	42.21	(80)
West	0.9x	0.54	x	1.89	x	94.68	x	0.63	x	0.7	=	38.35	(80)
West	0.9x	0.54	x	2.08	x	73.59	x	0.63	x	0.7	=	32.81	(80)
West	0.9x	0.54	x	1.89	x	73.59	x	0.63	x	0.7	=	29.81	(80)

West	0.9x	0.54	x	2.08	x	45.59	x	0.63	x	0.7	=	20.32	(80)
West	0.9x	0.54	x	1.89	x	45.59	x	0.63	x	0.7	=	18.47	(80)
West	0.9x	0.54	x	2.08	x	24.49	x	0.63	x	0.7	=	10.92	(80)
West	0.9x	0.54	x	1.89	x	24.49	x	0.63	x	0.7	=	9.92	(80)
West	0.9x	0.54	x	2.08	x	16.15	x	0.63	x	0.7	=	7.2	(80)
West	0.9x	0.54	x	1.89	x	16.15	x	0.63	x	0.7	=	6.54	(80)

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

(83)m=	162.92	285.71	407.22	522.97	596.09	594.6	572.21	518.37	448.02	320.69	196.77	138.3	(83)

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

(84)m=	644.08	764.61	870.36	960.52	1007.39	980.81	942.27	894.88	837.8	736.28	642.02	606.09	(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	0.88	0.73	0.56	0.61	0.84	0.97	1	1	(86)

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

(87)m=	19.71	19.88	20.15	20.48	20.77	20.94	20.99	20.98	20.87	20.49	20.04	19.68	(87)

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

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

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

(89)m=	1	0.99	0.98	0.94	0.84	0.64	0.43	0.48	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=	18.21	18.46	18.85	19.34	19.71	19.91	19.95	19.95	19.85	19.36	18.7	18.17	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	18.5	18.74	19.1	19.56	19.91	20.11	20.15	20.14	20.04	19.57	18.95	18.46	(92)

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

(93)m=	18.5	18.74	19.1	19.56	19.91	20.11	20.15	20.14	20.04	19.57	18.95	18.46	(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	0.84	0.65	0.46	0.5	0.77	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	641.31	757	849.05	897.6	843.46	640.02	430.89	451.23	647.44	701.31	636.08	604.13	(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=	1796.54	1746.54	1586.69	1326.04	1020.01	676.85	435.91	459.31	733.06	1114.37	1478.36	1787.16	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	859.49	664.97	548.8	308.48	131.35	0	0	0	0	307.32	606.44	880.17	(98)

TER WorkSheet: New dwelling design stage

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4307.02 (98)

Space heating requirement in kWh/m²/year 40.58 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system			0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =		1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =		1	(204)
Efficiency of main space heating system 1			93.5	(206)
Efficiency of secondary/supplementary heating system, %			0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	859.49	664.97	548.8	308.48	131.35	0	0	0	0	307.32	606.44	880.17		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	919.24	711.2	586.95	329.92	140.48	0	0	0	0	328.68	648.6	941.36		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4606.44	(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)	210.46	185.4	194.48	174.03	170.31	151.85	145.52	160.11	159.97	180.47	191.23	205.29		
Efficiency of water heater													79.8	(216)
(217)m=	88.17	87.93	87.43	86.33	84.13	79.8	79.8	79.8	79.8	86.22	87.68	88.26		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	238.69	210.85	222.44	201.59	202.43	190.29	182.36	200.64	200.46	209.31	218.09	232.59		
Total = Sum(219a)$_{1...12}$ =													2509.74	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4606.44	
Water heating fuel used			2509.74	
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			425.5	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	994.99	(261)

TER WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	542.1	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1537.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	220.83	(268)
Total CO2, kg/year		sum of (265)…(271) =		1796.85	(272)

TER =	16.93	(273)

Appendix B - Step Two – 'Be Lean' Output Document and Energy Report Figures

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	57.7	(1a) x	2.5	(2a) =	144.25	(3a)
First floor	45.67	(1b) x	2.5	(2b) =	114.17	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	103.37	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	258.42	(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) = 77.35 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			3.69	x1/[1/(0.8)+ 0.04]		=	2.86			(27)
Windows Type 2			4.83	x1/[1/(0.8)+ 0.04]		=	3.74			(27)
Windows Type 3			3.01	x1/[1/(0.8)+ 0.04]		=	2.33			(27)
Windows Type 4			5.01	x1/[1/(0.8)+ 0.04]		=	3.88			(27)
Floor			57.7	x	0.13	=	7.501			(28)
Walls Type1	54.06	8.52	45.54	x	0.13	=	5.92			(29)
Walls Type2	48.74	8.02	40.72	x	0.13	=	5.29			(29)
Total area of elements, m²			162.61							(31)
Party wall			44.05	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.74 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.2 (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) =	48.94	(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=	22.3	22.05	21.8	20.56	20.32	19.08	19.08	18.83	19.57	20.32	20.81	21.31	(38)

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

(39)m=	71.24	70.99	70.74	69.5	69.25	68.01	68.01	67.77	68.51	69.25	69.75	70.24	

Average = Sum(39)$_{1\ldots12}$ /12= 69.44 (39)

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

(40)m=	0.69	0.69	0.68	0.67	0.67	0.66	0.66	0.66	0.66	0.67	0.67	0.68

Average = Sum(40)$_{1\ldots12}$ /12= 0.67 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N	2.77	(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	105.22	(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=	115.74	111.53	107.32	103.11	98.9	94.69	94.69	98.9	103.11	107.32	111.53	115.74

Total = Sum(44)$_{1\ldots12}$ = 1262.58 (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=	171.63	150.11	154.9	135.05	129.58	111.82	103.62	118.9	120.32	140.22	153.06	166.22

Total = Sum(45)$_{1\ldots12}$ = 1655.45 (45)

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

(46)m=	25.75	22.52	23.24	20.26	19.44	16.77	15.54	17.84	18.05	21.03	22.96	24.93	(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=	226.91	200.04	210.18	188.54	184.86	165.31	158.89	174.18	173.82	195.5	206.56	221.5	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	226.91	200.04	210.18	188.54	184.86	165.31	158.89	174.18	173.82	195.5	206.56	221.5

Output from water heater (annual)$_{1...12}$ — 2306.29 (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=	101.29	89.85	95.73	87.7	87.31	79.97	78.67	83.76	82.8	90.85	93.69	99.49	(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=	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	(66)

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

(67)m=	25.03	22.23	18.08	13.69	10.23	8.64	9.33	12.13	16.28	20.67	24.13	25.72	(67)

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

(68)m=	261.66	264.38	257.54	242.97	224.58	207.3	195.76	193.04	199.88	214.45	232.84	250.12	(68)

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

(69)m=	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	(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=	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	(71)

Water heating gains (Table 5)

(72)m=	136.14	133.71	128.66	121.8	117.35	111.08	105.74	112.58	115	122.1	130.12	133.72	(72)

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

(73)m=	487.36	484.85	468.81	442.99	416.69	391.54	375.36	382.27	395.7	421.76	451.62	474.09	(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)	
North	0.9x	0.77	x	3.69	x	10.63	x	0.4	x	0.7	=	7.61	(74)
North	0.9x	0.77	x	4.83	x	10.63	x	0.4	x	0.7	=	9.97	(74)
North	0.9x	0.77	x	3.01	x	10.63	x	0.4	x	0.7	=	6.21	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.4	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.69	x	20.32	x	0.4	x	0.7	=	14.55	(74)
North	0.9x	0.77	x	4.83	x	20.32	x	0.4	x	0.7	=	19.05	(74)
North	0.9x	0.77	x	3.01	x	20.32	x	0.4	x	0.7	=	11.87	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.4	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	3.69	x	34.53	x	0.4	x	0.7	=	24.72	(74)
North	0.9x	0.77	x	4.83	x	34.53	x	0.4	x	0.7	=	32.36	(74)
North	0.9x	0.77	x	3.01	x	34.53	x	0.4	x	0.7	=	20.17	(74)
North	0.9x	0.77	x	5.01	x	34.53	x	0.4	x	0.7	=	33.57	(74)
North	0.9x	0.77	x	3.69	x	55.46	x	0.4	x	0.7	=	39.71	(74)
North	0.9x	0.77	x	4.83	x	55.46	x	0.4	x	0.7	=	51.98	(74)
North	0.9x	0.77	x	3.01	x	55.46	x	0.4	x	0.7	=	32.39	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.4	x	0.7	=	53.92	(74)
North	0.9x	0.77	x	3.69	x	74.72	x	0.4	x	0.7	=	53.5	(74)
North	0.9x	0.77	x	4.83	x	74.72	x	0.4	x	0.7	=	70.02	(74)
North	0.9x	0.77	x	3.01	x	74.72	x	0.4	x	0.7	=	43.64	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.4	x	0.7	=	72.63	(74)
North	0.9x	0.77	x	3.69	x	79.99	x	0.4	x	0.7	=	57.27	(74)
North	0.9x	0.77	x	4.83	x	79.99	x	0.4	x	0.7	=	74.96	(74)
North	0.9x	0.77	x	3.01	x	79.99	x	0.4	x	0.7	=	46.72	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.4	x	0.7	=	77.76	(74)
North	0.9x	0.77	x	3.69	x	74.68	x	0.4	x	0.7	=	53.47	(74)
North	0.9x	0.77	x	4.83	x	74.68	x	0.4	x	0.7	=	69.99	(74)
North	0.9x	0.77	x	3.01	x	74.68	x	0.4	x	0.7	=	43.62	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.4	x	0.7	=	72.6	(74)
North	0.9x	0.77	x	3.69	x	59.25	x	0.4	x	0.7	=	42.42	(74)
North	0.9x	0.77	x	4.83	x	59.25	x	0.4	x	0.7	=	55.53	(74)
North	0.9x	0.77	x	3.01	x	59.25	x	0.4	x	0.7	=	34.6	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.4	x	0.7	=	57.6	(74)
North	0.9x	0.77	x	3.69	x	41.52	x	0.4	x	0.7	=	29.73	(74)
North	0.9x	0.77	x	4.83	x	41.52	x	0.4	x	0.7	=	38.91	(74)
North	0.9x	0.77	x	3.01	x	41.52	x	0.4	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.4	x	0.7	=	40.36	(74)
North	0.9x	0.77	x	3.69	x	24.19	x	0.4	x	0.7	=	17.32	(74)
North	0.9x	0.77	x	4.83	x	24.19	x	0.4	x	0.7	=	22.67	(74)
North	0.9x	0.77	x	3.01	x	24.19	x	0.4	x	0.7	=	14.13	(74)

North	0.9x	0.77	x	5.01	x	24.19	x	0.4	x	0.7	=	23.52	(74)
North	0.9x	0.77	x	3.69	x	13.12	x	0.4	x	0.7	=	9.39	(74)
North	0.9x	0.77	x	4.83	x	13.12	x	0.4	x	0.7	=	12.29	(74)
North	0.9x	0.77	x	3.01	x	13.12	x	0.4	x	0.7	=	7.66	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.4	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	3.69	x	8.86	x	0.4	x	0.7	=	6.35	(74)
North	0.9x	0.77	x	4.83	x	8.86	x	0.4	x	0.7	=	8.31	(74)
North	0.9x	0.77	x	3.01	x	8.86	x	0.4	x	0.7	=	5.18	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.4	x	0.7	=	8.62	(74)

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

(83)m=	34.13	65.22	110.82	178.01	239.79	256.71	239.67	190.15	133.24	77.63	42.1	28.45	(83)

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

(84)m=	521.49	550.07	579.63	621	656.48	648.25	615.03	572.42	528.94	499.39	493.72	502.54	(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	0.88	0.66	0.49	0.54	0.83	0.98	1	1	(86)

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

(87)m=	20.34	20.41	20.55	20.77	20.93	20.99	21	21	20.97	20.77	20.53	20.33	(87)

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

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

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

(89)m=	1	1	0.99	0.97	0.84	0.6	0.42	0.47	0.78	0.97	1	1	(89)

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

(90)m=	19.45	19.56	19.77	20.08	20.3	20.37	20.38	20.38	20.35	20.09	19.73	19.44	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.71	19.81	20	20.28	20.49	20.56	20.56	20.56	20.53	20.29	19.96	19.7	(92)

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

(93)m=	19.71	19.81	20	20.28	20.49	20.56	20.56	20.56	20.53	20.29	19.96	19.7	(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	0.96	0.85	0.62	0.44	0.49	0.79	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	520.61	548.39	574.84	598.56	558.81	401.52	269.11	281.49	419.27	486.09	491.68	501.9	(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=	1097.49	1058.13	954.76	790.83	608.41	405.04	269.31	281.96	440.43	671.04	897.26	1088.61	(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=	429.2	342.54	282.66	138.43	36.9	0	0	0	0	137.6	292.02	436.51

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2095.88 (98)

Space heating requirement in kWh/m²/year 20.28 (99)

9b. Energy requirements – Community heating scheme

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

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

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

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

Fraction of heat from Community boilers 1 (303a)

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

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

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

Space heating **kWh/year**

Annual space heating requirement 2095.88

Space heat from Community boilers (98) x (304a) x (305) x (306) = 2305.47 (307a)

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

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

Water heating

Annual water heating requirement 2306.29

If DHW from community scheme:

Water heat from Community boilers (64) x (303a) x (305) x (306) = 2536.91 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 48.42 (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 315.28 (330a)

warm air heating system fans 0 (330b)

pump for solar water heating 0 (330g)

Total electricity for the above, kWh/year =(330a) + (330b) + (330g) = 315.28 (331)

Energy for lighting (calculated in Appendix L) 441.96 (332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	1089.54	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	25.13	(372)

DER WorkSheet: New dwelling design stage

Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1114.67	(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) =			1114.67	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	163.63	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	229.38	(379)
Total CO2, kg/year	sum of (376)…(382) =			1507.68	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.59	(384)
EI rating (section 14)				86.38	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.32	(1a) x	2.5	(2a) =	125.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.32	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.8	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.35	(23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			3.33	x1/[1/(0.8)+ 0.04]		=	2.58			(27)
Windows Type 2			5.01	x1/[1/(0.8)+ 0.04]		=	3.88			(27)
Walls	59.49	10.44	49.05	x	0.13	=	6.38			(29)
Total area of elements, m²			59.49							(31)
Party wall			17.5	x	0	=	0			(32)

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	17.04	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		6.85	(36)

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

Total fabric heat loss	(33) + (36) =	23.89	(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=	10.85	10.73	10.61	10.01	9.89	9.29	9.29	9.17	9.53	9.89	10.13	10.37	(38)

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

(39)m=	34.75	34.63	34.5	33.9	33.78	33.18	33.18	33.06	33.42	33.78	34.02	34.26	

Average = Sum(39)$_{1…12}$ /12= 33.87 (39)

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

(40)m=	0.69	0.69	0.69	0.67	0.67	0.66	0.66	0.66	0.66	0.67	0.68	0.68

Average = Sum(40)$_{1…12}$ /12= 0.67 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34

Total = Sum(44)$_{1…12}$ = 941.86 (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=	128.04	111.98	115.55	100.74	96.66	83.41	77.3	88.7	89.76	104.6	114.18	124

Total = Sum(45)$_{1…12}$ = 1234.92 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.3	13.46	15.69	17.13	18.6	(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)

DER WorkSheet: New dwelling design stage

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

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

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

(62)m=	183.31	161.91	170.83	154.24	151.94	136.91	132.57	143.97	143.25	159.88	167.68	179.27	(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=	183.31	161.91	170.83	154.24	151.94	136.91	132.57	143.97	143.25	159.88	167.68	179.27	

Output from water heater (annual)$_{1...12}$ 1885.76 (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=	86.79	77.18	82.64	76.29	76.36	70.53	69.92	73.71	72.64	79	80.76	85.45	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.05	12.48	10.15	7.69	5.74	4.85	5.24	6.81	9.14	11.61	13.55	14.44	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	148.07	149.6	145.73	137.49	127.08	117.3	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table 5)													
(72)m=	116.66	114.84	111.08	105.96	102.64	97.96	93.98	99.08	100.89	106.19	112.17	114.85	(72)
Total internal gains =						(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m							
(73)m=	327.27	325.42	315.45	299.63	283.96	268.6	258.49	263.62	271.63	287.64	305.96	319.32	(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)	
North	0.9x	0.77	x	3.33	x	10.63	x	0.4	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.4	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.33	x	20.32	x	0.4	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.4	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	3.33	x	34.53	x	0.4	x	0.7	=	22.31	(74)

North	0.9x	0.77	x	5.01	x	34.53	x	0.4	x	0.7	=	33.57	(74)
North	0.9x	0.77	x	3.33	x	55.46	x	0.4	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.4	x	0.7	=	53.92	(74)
North	0.9x	0.77	x	3.33	x	74.72	x	0.4	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.4	x	0.7	=	72.63	(74)
North	0.9x	0.77	x	3.33	x	79.99	x	0.4	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.4	x	0.7	=	77.76	(74)
North	0.9x	0.77	x	3.33	x	74.68	x	0.4	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.4	x	0.7	=	72.6	(74)
North	0.9x	0.77	x	3.33	x	59.25	x	0.4	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.4	x	0.7	=	57.6	(74)
North	0.9x	0.77	x	3.33	x	41.52	x	0.4	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.4	x	0.7	=	40.36	(74)
North	0.9x	0.77	x	3.33	x	24.19	x	0.4	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	5.01	x	24.19	x	0.4	x	0.7	=	23.52	(74)
North	0.9x	0.77	x	3.33	x	13.12	x	0.4	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.4	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	3.33	x	8.86	x	0.4	x	0.7	=	5.73	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.4	x	0.7	=	8.62	(74)

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

(83)m=	17.21	32.89	55.88	89.76	120.91	129.44	120.85	95.88	67.19	39.15	21.23	14.35	(83)

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

(84)m=	344.48	358.31	371.33	389.38	404.87	398.04	379.33	359.49	338.82	326.78	327.19	333.67	(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=	0.99	0.99	0.97	0.91	0.75	0.53	0.38	0.42	0.67	0.92	0.98	0.99	(86)

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

(87)m=	20.51	20.59	20.72	20.89	20.98	21	21	21	20.99	20.89	20.69	20.5	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.89	0.71	0.48	0.33	0.37	0.61	0.89	0.98	0.99	(89)

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

(90)m=	19.7	19.81	20	20.23	20.35	20.38	20.38	20.38	20.37	20.25	19.97	19.69	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	20.09	20.18	20.34	20.55	20.65	20.68	20.68	20.68	20.67	20.56	20.32	20.08	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	20.09	20.18	20.34	20.55	20.65	20.68	20.68	20.68	20.67	20.56	20.32	20.08	(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=	0.99	0.98	0.96	0.89	0.73	0.51	0.36	0.39	0.64	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	340.87	352.42	358.13	347.86	294.1	201.14	135.22	141.35	217.01	294.14	319.37	330.78	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	548.76	529.12	477.61	394.85	302.34	201.56	135.24	141.4	219.49	336.46	449.61	544.16	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	154.67	118.74	88.89	33.83	6.13	0	0	0	0	31.49	93.78	158.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	686.29	(98)
Space heating requirement in kWh/m²/year	13.64	(99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		686.29	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	754.92	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1885.76	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2074.34	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	28.29	(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		136.21	(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) =		136.21	(331)
Energy for lighting (calculated in Appendix L)			248.2	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	636.58	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	14.68	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	651.27	(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) =				651.27	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	70.69	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	128.81	(379)
Total CO2, kg/year	sum of (376)…(382) =				850.77	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				16.91	(384)
EI rating (section 14)					88.04	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.88	(1a) x	2.5	(2a) =	167.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.2	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			19.23	x1/[1/(0.8)+ 0.04]		=	14.91			(27)
Windows Type 2			9.5	x1/[1/(0.8)+ 0.04]		=	7.36			(27)
Windows Type 3			20.61	x1/[1/(0.8)+ 0.04]		=	15.98			(27)
Walls	95.5	51.44	44.06	x	0.13	=	5.73			(29)
Total area of elements, m²			95.5							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.18 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.1 (36)

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

Total fabric heat loss (33) + (36) = 56.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.43	14.27	14.11	13.3	13.14	12.34	12.34	12.18	12.66	13.14	13.46	13.79	(38)

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

(39)m=	70.7	70.54	70.38	69.58	69.42	68.62	68.62	68.46	68.94	69.42	69.74	70.06	

Average = Sum(39)$_{1…12}$ /12= 69.54 (39)

DER WorkSheet: New dwelling design stage

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=	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.02	1.03	1.04	1.04	1.05	

Average = $Sum(40)_{1…12}$ /12= 1.04 (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 2.17 (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 90.2 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.22	95.61	92.01	88.4	84.79	81.18	81.18	84.79	88.4	92.01	95.61	99.22	

Total = $Sum(44)_{1…12}$ = 1082.42 (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	147.14	128.69	132.8	115.78	111.09	95.86	88.83	101.94	103.15	120.21	131.22	142.5	

Total = $Sum(45)_{1…12}$ = 1419.22 (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=	22.07	19.3	19.92	17.37	16.66	14.38	13.32	15.29	15.47	18.03	19.68	21.38	(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

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

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

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

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

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

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

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

DER WorkSheet: New dwelling design stage

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

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

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

(62)m=	202.42	178.62	188.08	169.27	166.37	149.36	144.11	157.21	156.65	175.49	184.72	197.78	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	202.42	178.62	188.08	169.27	166.37	149.36	144.11	157.21	156.65	175.49	184.72	197.78	

Output from water heater (annual)$_{1...12}$ 2070.06 (64)

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

(65)m=	93.15	82.73	88.38	81.29	81.16	74.67	73.76	78.11	77.09	84.19	86.43	91.6	(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=	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	(66)

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

(67)m=	16.93	15.04	12.23	9.26	6.92	5.84	6.31	8.21	11.01	13.99	16.32	17.4	(67)

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

(68)m=	189.91	191.88	186.91	176.34	163	150.45	142.07	140.1	145.07	155.64	168.99	181.53	(68)

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

(69)m=	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	(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=	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	(71)

Water heating gains (Table 5)

(72)m=	125.2	123.11	118.79	112.9	109.08	103.71	99.14	104.99	107.07	113.16	120.04	123.12	(72)

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

(73)m=	387.56	385.55	373.45	354.02	334.52	315.52	303.05	308.82	318.68	338.31	360.87	377.57	(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)	
East	0.9x	1	x	19.23	x	19.64	x	0.4	x	0.7	=	51.4	(76)
East	0.9x	1	x	19.23	x	38.42	x	0.4	x	0.7	=	100.54	(76)
East	0.9x	1	x	19.23	x	63.27	x	0.4	x	0.7	=	165.57	(76)
East	0.9x	1	x	19.23	x	92.28	x	0.4	x	0.7	=	241.48	(76)
East	0.9x	1	x	19.23	x	113.09	x	0.4	x	0.7	=	295.94	(76)

East	0.9x	1	x	19.23	x	115.77	x	0.4	x	0.7	=	302.95	(76)
East	0.9x	1	x	19.23	x	110.22	x	0.4	x	0.7	=	288.42	(76)
East	0.9x	1	x	19.23	x	94.68	x	0.4	x	0.7	=	247.75	(76)
East	0.9x	1	x	19.23	x	73.59	x	0.4	x	0.7	=	192.57	(76)
East	0.9x	1	x	19.23	x	45.59	x	0.4	x	0.7	=	119.3	(76)
East	0.9x	1	x	19.23	x	24.49	x	0.4	x	0.7	=	64.08	(76)
East	0.9x	1	x	19.23	x	16.15	x	0.4	x	0.7	=	42.26	(76)
South	0.9x	0.54	x	9.5	x	46.75	x	0.4	x	0.7	=	60.44	(78)
South	0.9x	0.54	x	9.5	x	76.57	x	0.4	x	0.7	=	98.98	(78)
South	0.9x	0.54	x	9.5	x	97.53	x	0.4	x	0.7	=	126.09	(78)
South	0.9x	0.54	x	9.5	x	110.23	x	0.4	x	0.7	=	142.51	(78)
South	0.9x	0.54	x	9.5	x	114.87	x	0.4	x	0.7	=	148.5	(78)
South	0.9x	0.54	x	9.5	x	110.55	x	0.4	x	0.7	=	142.91	(78)
South	0.9x	0.54	x	9.5	x	108.01	x	0.4	x	0.7	=	139.63	(78)
South	0.9x	0.54	x	9.5	x	104.89	x	0.4	x	0.7	=	135.6	(78)
South	0.9x	0.54	x	9.5	x	101.89	x	0.4	x	0.7	=	131.71	(78)
South	0.9x	0.54	x	9.5	x	82.59	x	0.4	x	0.7	=	106.76	(78)
South	0.9x	0.54	x	9.5	x	55.42	x	0.4	x	0.7	=	71.64	(78)
South	0.9x	0.54	x	9.5	x	40.4	x	0.4	x	0.7	=	52.23	(78)
West	0.9x	0.54	x	20.61	x	19.64	x	0.4	x	0.7	=	55.08	(80)
West	0.9x	0.54	x	20.61	x	38.42	x	0.4	x	0.7	=	107.75	(80)
West	0.9x	0.54	x	20.61	x	63.27	x	0.4	x	0.7	=	177.46	(80)
West	0.9x	0.54	x	20.61	x	92.28	x	0.4	x	0.7	=	258.81	(80)
West	0.9x	0.54	x	20.61	x	113.09	x	0.4	x	0.7	=	317.18	(80)
West	0.9x	0.54	x	20.61	x	115.77	x	0.4	x	0.7	=	324.69	(80)
West	0.9x	0.54	x	20.61	x	110.22	x	0.4	x	0.7	=	309.12	(80)
West	0.9x	0.54	x	20.61	x	94.68	x	0.4	x	0.7	=	265.53	(80)
West	0.9x	0.54	x	20.61	x	73.59	x	0.4	x	0.7	=	206.39	(80)
West	0.9x	0.54	x	20.61	x	45.59	x	0.4	x	0.7	=	127.86	(80)
West	0.9x	0.54	x	20.61	x	24.49	x	0.4	x	0.7	=	68.68	(80)
West	0.9x	0.54	x	20.61	x	16.15	x	0.4	x	0.7	=	45.3	(80)

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

(83)m=	166.92	307.28	469.12	642.8	761.62	770.55	737.17	648.88	530.67	353.92	204.41	139.79	(83)

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

(84)m=	554.47	692.83	842.57	996.82	1096.15	1086.08	1040.22	957.71	849.35	692.23	565.27	517.36	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.91	0.77	0.58	0.4	0.29	0.33	0.55	0.86	0.98	0.99	(86)

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

(87)m=	20.1	20.34	20.64	20.89	20.98	21	21	21	20.99	20.82	20.4	20.05	(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.04	20.04	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04	(88)

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

(89)m=	0.99	0.96	0.89	0.72	0.52	0.34	0.23	0.26	0.48	0.82	0.97	0.99	(89)

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

(90)m=	18.85	19.2	19.62	19.93	20.03	20.06	20.06	20.06	20.05	19.87	19.3	18.79	(90)

fLA = Living area ÷ (4) = 0.56 (91)

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

(92)m=	19.55	19.84	20.19	20.47	20.56	20.59	20.59	20.59	20.58	20.4	19.92	19.5	(92)

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

(93)m=	19.55	19.84	20.19	20.47	20.56	20.59	20.59	20.59	20.58	20.4	19.92	19.5	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.89	0.74	0.55	0.38	0.26	0.3	0.52	0.84	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	546.84	666.24	753.59	740.37	603.47	409.52	273.48	286.45	440.1	580.01	547.16	512.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1078.33	1053.8	963.52	804.96	615.28	410.72	273.61	286.71	446.39	680.48	894.03	1071.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	395.43	260.44	156.19	46.51	8.79	0	0	0	0	74.75	249.75	416.38	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1608.23 (98)

Space heating requirement in kWh/m²/year 24.05 (99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none	0	(301)
Fraction of space heat from community system 1 – (301) =	1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		1608.23	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	1769.06	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308

DER WorkSheet: New dwelling design stage

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

Water heating

Annual water heating requirement		2070.06	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2277.07	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	40.46	(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		234.58	(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) =	234.58	(331)
Energy for lighting (calculated in Appendix L)		299	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	910.38	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	21	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	931.38	(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) =				931.38	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	121.75	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	155.18	(379)
Total CO2, kg/year	sum of (376)…(382) =				1208.3	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				18.07	(384)
EI rating (section 14)					85.53	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.18	(1a) x	2.5	(2a) =	177.95	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.95	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			8.25	x1/[1/(0.8)+ 0.04]		=	6.4			(27)
Windows Type 2			15.71	x1/[1/(0.8)+ 0.04]		=	12.18			(27)
Walls	91.8	26.06	65.74	x	0.13	=	8.55			(29)
Roof	71.18	0	71.18	x	0.12	=	8.54			(30)
Total area of elements, m²			162.98							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 39.86 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.8 (36)

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

Total fabric heat loss (33) + (36) = 53.66 (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=	15.35	15.18	15.01	14.16	13.99	13.14	13.14	12.97	13.48	13.99	14.33	14.67	(38)

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

(39)m=	69.02	68.85	68.67	67.82	67.65	66.8	66.8	66.63	67.14	67.65	67.99	68.33	

Average = Sum(39)$_{1…12}$ /12= 67.78 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	0.97	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.95	0.96	0.96

Average = Sum(40)$_{1…12}$ /12= 0.95 (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 2.27 (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 92.86 (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=	102.15	98.43	94.72	91	87.29	83.57	83.57	87.29	91	94.72	98.43	102.15

Total = Sum(44)$_{1…12}$ = 1114.33 (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=	151.48	132.49	136.71	119.19	114.37	98.69	91.45	104.94	106.19	123.76	135.09	146.7

Total = Sum(45)$_{1…12}$ = 1461.06 (45)

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

(46)m=	22.72	19.87	20.51	17.88	17.15	14.8	13.72	15.74	15.93	18.56	20.26	22.01	(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=	206.76	182.41	191.99	172.68	169.64	152.18	146.73	160.22	159.69	179.04	188.59	201.98	(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=	206.76	182.41	191.99	172.68	169.64	152.18	146.73	160.22	159.69	179.04	188.59	201.98	

Output from water heater (annual)$_{1...12}$ 2111.9 (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=	94.59	83.99	89.68	82.43	82.25	75.61	74.63	79.11	78.1	85.37	87.71	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=	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	(66)

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

(67)m=	17.83	15.84	12.88	9.75	7.29	6.15	6.65	8.64	11.6	14.73	17.19	18.33	(67)

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

(68)m=	200.04	202.11	196.88	185.74	171.69	158.48	149.65	147.57	152.81	163.94	178	191.21	(68)

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

(69)m=	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	(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=	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	(71)

Water heating gains (Table 5)

(72)m=	127.14	124.99	120.54	114.48	110.55	105.01	100.31	106.34	108.48	114.75	121.82	125	(72)

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

(73)m=	402.12	400.06	387.41	367.09	346.64	326.76	313.72	319.67	330	350.53	374.13	391.65	(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)	
North	0.9x	0.54	x	15.71	x	10.63	x	0.4	x	0.7	=	22.73	(74)
North	0.9x	0.54	x	15.71	x	20.32	x	0.4	x	0.7	=	43.44	(74)
North	0.9x	0.54	x	15.71	x	34.53	x	0.4	x	0.7	=	73.82	(74)
North	0.9x	0.54	x	15.71	x	55.46	x	0.4	x	0.7	=	118.57	(74)
North	0.9x	0.54	x	15.71	x	74.72	x	0.4	x	0.7	=	159.73	(74)

North	0.9x	0.54	x	15.71	x	79.99	x	0.4	x	0.7	=	170.99	(74)
North	0.9x	0.54	x	15.71	x	74.68	x	0.4	x	0.7	=	159.64	(74)
North	0.9x	0.54	x	15.71	x	59.25	x	0.4	x	0.7	=	126.66	(74)
North	0.9x	0.54	x	15.71	x	41.52	x	0.4	x	0.7	=	88.75	(74)
North	0.9x	0.54	x	15.71	x	24.19	x	0.4	x	0.7	=	51.71	(74)
North	0.9x	0.54	x	15.71	x	13.12	x	0.4	x	0.7	=	28.04	(74)
North	0.9x	0.54	x	15.71	x	8.86	x	0.4	x	0.7	=	18.95	(74)
West	0.9x	0.54	x	8.25	x	19.64	x	0.4	x	0.7	=	22.05	(80)
West	0.9x	0.54	x	8.25	x	38.42	x	0.4	x	0.7	=	43.13	(80)
West	0.9x	0.54	x	8.25	x	63.27	x	0.4	x	0.7	=	71.03	(80)
West	0.9x	0.54	x	8.25	x	92.28	x	0.4	x	0.7	=	103.6	(80)
West	0.9x	0.54	x	8.25	x	113.09	x	0.4	x	0.7	=	126.96	(80)
West	0.9x	0.54	x	8.25	x	115.77	x	0.4	x	0.7	=	129.97	(80)
West	0.9x	0.54	x	8.25	x	110.22	x	0.4	x	0.7	=	123.74	(80)
West	0.9x	0.54	x	8.25	x	94.68	x	0.4	x	0.7	=	106.29	(80)
West	0.9x	0.54	x	8.25	x	73.59	x	0.4	x	0.7	=	82.62	(80)
West	0.9x	0.54	x	8.25	x	45.59	x	0.4	x	0.7	=	51.18	(80)
West	0.9x	0.54	x	8.25	x	24.49	x	0.4	x	0.7	=	27.49	(80)
West	0.9x	0.54	x	8.25	x	16.15	x	0.4	x	0.7	=	18.13	(80)

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

(83)m=	44.78	86.58	144.85	222.17	286.69	300.96	283.38	232.95	171.37	102.89	55.54	37.08	(83)

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

(84)m=	446.9	486.63	532.27	589.27	633.34	627.72	597.11	552.62	501.37	453.43	429.67	428.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.85	0.66	0.49	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=	20.04	20.15	20.36	20.65	20.88	20.98	21	20.99	20.93	20.64	20.29	20.02	(87)

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

(88)m=	20.11	20.11	20.11	20.12	20.12	20.13	20.13	20.14	20.13	20.12	20.12	20.12	(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	0.58	0.39	0.45	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=	18.82	18.98	19.29	19.71	20.01	20.12	20.13	20.13	20.07	19.7	19.2	18.8	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	19.22	19.37	19.64	20.02	20.29	20.41	20.42	20.42	20.36	20.01	19.56	19.2	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	19.22	19.37	19.64	20.02	20.29	20.41	20.42	20.42	20.36	20.01	19.56	19.2	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.82	0.6	0.43	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	444.86	482.66	521.77	552.04	516.52	379.01	254.24	265.96	386.14	433.76	425.63	427.17	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1029.9	996.22	902.68	754.08	581.44	387.84	255.19	267.84	420.1	636.93	847.41	1025.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	435.27	345.11	283.4	145.46	48.3	0	0	0	0	151.16	303.68	444.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2157.19 (98)

Space heating requirement in kWh/m²/year 30.31 (99)

9b. Energy requirements – Community heating scheme

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

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2157.19	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2372.91	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2111.9	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2323.09	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	46.96	(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		249.66	(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) =		249.66	(331)
Energy for lighting (calculated in Appendix L)			314.94	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			96	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0 =	1056.6	(367)
Electrical energy for heat distribution	[(313) x		0.52 =	24.37	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	1080.97	(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) =			1080.97	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52 =	129.58	(378)
CO2 associated with electricity for lighting	(332))) x		0.52 =	163.45	(379)
Total CO2, kg/year	sum of (376)…(382) =			1374	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			19.3	(384)
EI rating (section 14)				84.15	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	42.57	(1a)	x	2.5	(2a)	=	106.42	(3a)
First floor	32.51	(1b)	x	2.5	(2b)	=	81.27	(3b)
Second floor	31.06	(1c)	x	2.5	(2c)	=	77.65	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	106.14	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	265.35	(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) = 63.7 (23c)

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

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

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.34	0.32	0.32	0.3	0.3	0.3	0.31	0.32	0.32	0.33	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			6.21	x1/[1/(0.8)+ 0.04]		=	4.81			(27)
Windows Type 2			9.55	x1/[1/(0.8)+ 0.04]		=	7.4			(27)
Windows Type 3			9.82	x1/[1/(0.8)+ 0.04]		=	7.61			(27)
Windows Type 4			5.77	x1/[1/(0.8)+ 0.04]		=	4.47			(27)
Windows Type 5			9.55	x1/[1/(0.8)+ 0.04]		=	7.4			(27)
Windows Type 6			6.5	x1/[1/(0.8)+ 0.04]		=	5.04			(27)
Windows Type 7			5.24	x1/[1/(0.8)+ 0.04]		=	4.06			(27)
Windows Type 8			5.57	x1/[1/(0.8)+ 0.04]		=	4.32			(27)
Windows Type 9			4.07	x1/[1/(0.8)+ 0.04]		=	3.16			(27)
Windows Type 10			5.62	x1/[1/(0.8)+ 0.04]		=	4.36			(27)
Walls Type1	40.22	25.58	14.64	x	0.13	=	1.9			(29)
Walls Type2	39.17	21.82	17.35	x	0.13	=	2.26			(29)
Walls Type3	39.17	20.5	18.67	x	0.13	=	2.43			(29)
Roof	31.06	0	31.06	x	0.12	=	3.73			(30)
Total area of elements, m²			151.71							(31)
Party wall			63.1	x	0	=	0			(32)

DER WorkSheet: New dwelling design stage

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	67.15	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		11.1	(36)

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

Total fabric heat loss	(33) + (36) =	78.25	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.13	29.85	29.57	28.17	27.9	26.5	26.5	26.22	27.06	27.9	28.45	29.01	(38)

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

(39)m=	108.38	108.1	107.82	106.42	106.14	104.75	104.75	104.47	105.31	106.14	106.7	107.26	

Average = Sum(39)$_{1…12}$ /12= 106.35 (39)

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

(40)m=	1.02	1.02	1.02	1	1	0.99	0.99	0.98	0.99	1	1.01	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 2.79 (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) + 36 105.74 (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=	116.31	112.08	107.85	103.62	99.39	95.17	95.17	99.39	103.62	107.85	112.08	116.31

Total = Sum(44)$_{1…12}$ = 1268.87 (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=	172.49	150.86	155.67	135.72	130.23	112.38	104.13	119.49	120.92	140.92	153.83	167.05

Total = Sum(45)$_{1…12}$ = 1663.69 (45)

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

(46)m=	25.87	22.63	23.35	20.36	19.53	16.86	15.62	17.92	18.14	21.14	23.07	25.06	(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=	227.77	200.79	210.95	189.21	185.5	165.87	159.41	174.77	174.41	196.2	207.32	222.32	(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=	227.77	200.79	210.95	189.21	185.5	165.87	159.41	174.77	174.41	196.2	207.32	222.32

Output from water heater (annual)$_{1...12}$ — 2314.53 (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=	101.57	90.1	95.98	87.92	87.52	80.16	78.85	83.95	83	91.08	93.94	99.76	(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=	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	(66)

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

(67)m=	23.7	21.05	17.12	12.96	9.69	8.18	8.84	11.49	15.42	19.58	22.85	24.36	(67)

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

(68)m=	265.89	268.65	261.7	246.89	228.21	210.65	198.92	196.16	203.11	217.91	236.6	254.16	(68)

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

(69)m=	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	(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=	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	136.52	134.08	129.01	122.11	117.64	111.33	105.98	112.84	115.28	122.42	130.48	134.09	(72)

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

(73)m=	490.96	488.63	472.67	446.81	420.38	395.01	378.57	385.33	398.65	424.75	454.77	477.46	(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)	
East	0.9x	1	x	6.21	x	19.64	x	0.4	x	0.7	=	16.6	(76)
East	0.9x	1	x	9.82	x	19.64	x	0.4	x	0.7	=	26.25	(76)
East	0.9x	1	x	6.5	x	19.64	x	0.4	x	0.7	=	17.37	(76)
East	0.9x	1	x	5.62	x	19.64	x	0.4	x	0.7	=	15.02	(76)
East	0.9x	1	x	6.21	x	38.42	x	0.4	x	0.7	=	32.47	(76)
East	0.9x	1	x	9.82	x	38.42	x	0.4	x	0.7	=	51.34	(76)
East	0.9x	1	x	6.5	x	38.42	x	0.4	x	0.7	=	33.98	(76)
East	0.9x	1	x	5.62	x	38.42	x	0.4	x	0.7	=	29.38	(76)
East	0.9x	1	x	6.21	x	63.27	x	0.4	x	0.7	=	53.47	(76)
East	0.9x	1	x	9.82	x	63.27	x	0.4	x	0.7	=	84.55	(76)
East	0.9x	1	x	6.5	x	63.27	x	0.4	x	0.7	=	55.97	(76)
East	0.9x	1	x	5.62	x	63.27	x	0.4	x	0.7	=	48.39	(76)
East	0.9x	1	x	6.21	x	92.28	x	0.4	x	0.7	=	77.98	(76)
East	0.9x	1	x	9.82	x	92.28	x	0.4	x	0.7	=	123.31	(76)
East	0.9x	1	x	6.5	x	92.28	x	0.4	x	0.7	=	81.62	(76)
East	0.9x	1	x	5.62	x	92.28	x	0.4	x	0.7	=	70.57	(76)
East	0.9x	1	x	6.21	x	113.09	x	0.4	x	0.7	=	95.57	(76)
East	0.9x	1	x	9.82	x	113.09	x	0.4	x	0.7	=	151.13	(76)
East	0.9x	1	x	6.5	x	113.09	x	0.4	x	0.7	=	100.03	(76)
East	0.9x	1	x	5.62	x	113.09	x	0.4	x	0.7	=	86.49	(76)
East	0.9x	1	x	6.21	x	115.77	x	0.4	x	0.7	=	97.83	(76)
East	0.9x	1	x	9.82	x	115.77	x	0.4	x	0.7	=	154.7	(76)
East	0.9x	1	x	6.5	x	115.77	x	0.4	x	0.7	=	102.4	(76)
East	0.9x	1	x	5.62	x	115.77	x	0.4	x	0.7	=	88.54	(76)
East	0.9x	1	x	6.21	x	110.22	x	0.4	x	0.7	=	93.14	(76)
East	0.9x	1	x	9.82	x	110.22	x	0.4	x	0.7	=	147.29	(76)
East	0.9x	1	x	6.5	x	110.22	x	0.4	x	0.7	=	97.49	(76)
East	0.9x	1	x	5.62	x	110.22	x	0.4	x	0.7	=	84.29	(76)
East	0.9x	1	x	6.21	x	94.68	x	0.4	x	0.7	=	80.01	(76)
East	0.9x	1	x	9.82	x	94.68	x	0.4	x	0.7	=	126.52	(76)
East	0.9x	1	x	6.5	x	94.68	x	0.4	x	0.7	=	83.74	(76)
East	0.9x	1	x	5.62	x	94.68	x	0.4	x	0.7	=	72.41	(76)

DER WorkSheet: New dwelling design stage

East	0.9x	1	x	6.21	x	73.59	x	0.4	x	0.7	=	62.19	(76)
East	0.9x	1	x	9.82	x	73.59	x	0.4	x	0.7	=	98.34	(76)
East	0.9x	1	x	6.5	x	73.59	x	0.4	x	0.7	=	65.09	(76)
East	0.9x	1	x	5.62	x	73.59	x	0.4	x	0.7	=	56.28	(76)
East	0.9x	1	x	6.21	x	45.59	x	0.4	x	0.7	=	38.53	(76)
East	0.9x	1	x	9.82	x	45.59	x	0.4	x	0.7	=	60.92	(76)
East	0.9x	1	x	6.5	x	45.59	x	0.4	x	0.7	=	40.32	(76)
East	0.9x	1	x	5.62	x	45.59	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	1	x	6.21	x	24.49	x	0.4	x	0.7	=	20.69	(76)
East	0.9x	1	x	9.82	x	24.49	x	0.4	x	0.7	=	32.72	(76)
East	0.9x	1	x	6.5	x	24.49	x	0.4	x	0.7	=	21.66	(76)
East	0.9x	1	x	5.62	x	24.49	x	0.4	x	0.7	=	18.73	(76)
East	0.9x	1	x	6.21	x	16.15	x	0.4	x	0.7	=	13.65	(76)
East	0.9x	1	x	9.82	x	16.15	x	0.4	x	0.7	=	21.58	(76)
East	0.9x	1	x	6.5	x	16.15	x	0.4	x	0.7	=	14.29	(76)
East	0.9x	1	x	5.62	x	16.15	x	0.4	x	0.7	=	12.35	(76)
South	0.9x	0.54	x	9.55	x	46.75	x	0.4	x	0.7	=	60.76	(78)
South	0.9x	0.54	x	9.55	x	46.75	x	0.4	x	0.7	=	60.76	(78)
South	0.9x	0.54	x	5.57	x	46.75	x	0.4	x	0.7	=	35.44	(78)
South	0.9x	0.54	x	4.07	x	46.75	x	0.4	x	0.7	=	25.89	(78)
South	0.9x	0.54	x	9.55	x	76.57	x	0.4	x	0.7	=	99.5	(78)
South	0.9x	0.54	x	9.55	x	76.57	x	0.4	x	0.7	=	99.5	(78)
South	0.9x	0.54	x	5.57	x	76.57	x	0.4	x	0.7	=	58.04	(78)
South	0.9x	0.54	x	4.07	x	76.57	x	0.4	x	0.7	=	42.41	(78)
South	0.9x	0.54	x	9.55	x	97.53	x	0.4	x	0.7	=	126.75	(78)
South	0.9x	0.54	x	9.55	x	97.53	x	0.4	x	0.7	=	126.75	(78)
South	0.9x	0.54	x	5.57	x	97.53	x	0.4	x	0.7	=	73.93	(78)
South	0.9x	0.54	x	4.07	x	97.53	x	0.4	x	0.7	=	54.02	(78)
South	0.9x	0.54	x	9.55	x	110.23	x	0.4	x	0.7	=	143.26	(78)
South	0.9x	0.54	x	9.55	x	110.23	x	0.4	x	0.7	=	143.26	(78)
South	0.9x	0.54	x	5.57	x	110.23	x	0.4	x	0.7	=	83.55	(78)
South	0.9x	0.54	x	4.07	x	110.23	x	0.4	x	0.7	=	61.05	(78)
South	0.9x	0.54	x	9.55	x	114.87	x	0.4	x	0.7	=	149.28	(78)
South	0.9x	0.54	x	9.55	x	114.87	x	0.4	x	0.7	=	149.28	(78)
South	0.9x	0.54	x	5.57	x	114.87	x	0.4	x	0.7	=	87.07	(78)
South	0.9x	0.54	x	4.07	x	114.87	x	0.4	x	0.7	=	63.62	(78)
South	0.9x	0.54	x	9.55	x	110.55	x	0.4	x	0.7	=	143.66	(78)
South	0.9x	0.54	x	9.55	x	110.55	x	0.4	x	0.7	=	143.66	(78)
South	0.9x	0.54	x	5.57	x	110.55	x	0.4	x	0.7	=	83.79	(78)
South	0.9x	0.54	x	4.07	x	110.55	x	0.4	x	0.7	=	61.23	(78)
South	0.9x	0.54	x	9.55	x	108.01	x	0.4	x	0.7	=	140.37	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.54	x	9.55	x	108.01	x	0.4	x	0.7	=	140.37	(78)
South	0.9x	0.54	x	5.57	x	108.01	x	0.4	x	0.7	=	81.87	(78)
South	0.9x	0.54	x	4.07	x	108.01	x	0.4	x	0.7	=	59.82	(78)
South	0.9x	0.54	x	9.55	x	104.89	x	0.4	x	0.7	=	136.32	(78)
South	0.9x	0.54	x	9.55	x	104.89	x	0.4	x	0.7	=	136.32	(78)
South	0.9x	0.54	x	5.57	x	104.89	x	0.4	x	0.7	=	79.51	(78)
South	0.9x	0.54	x	4.07	x	104.89	x	0.4	x	0.7	=	58.1	(78)
South	0.9x	0.54	x	9.55	x	101.89	x	0.4	x	0.7	=	132.41	(78)
South	0.9x	0.54	x	9.55	x	101.89	x	0.4	x	0.7	=	132.41	(78)
South	0.9x	0.54	x	5.57	x	101.89	x	0.4	x	0.7	=	77.23	(78)
South	0.9x	0.54	x	4.07	x	101.89	x	0.4	x	0.7	=	56.43	(78)
South	0.9x	0.54	x	9.55	x	82.59	x	0.4	x	0.7	=	107.33	(78)
South	0.9x	0.54	x	9.55	x	82.59	x	0.4	x	0.7	=	107.33	(78)
South	0.9x	0.54	x	5.57	x	82.59	x	0.4	x	0.7	=	62.6	(78)
South	0.9x	0.54	x	4.07	x	82.59	x	0.4	x	0.7	=	45.74	(78)
South	0.9x	0.54	x	9.55	x	55.42	x	0.4	x	0.7	=	72.02	(78)
South	0.9x	0.54	x	9.55	x	55.42	x	0.4	x	0.7	=	72.02	(78)
South	0.9x	0.54	x	5.57	x	55.42	x	0.4	x	0.7	=	42	(78)
South	0.9x	0.54	x	4.07	x	55.42	x	0.4	x	0.7	=	30.69	(78)
South	0.9x	0.54	x	9.55	x	40.4	x	0.4	x	0.7	=	52.5	(78)
South	0.9x	0.54	x	9.55	x	40.4	x	0.4	x	0.7	=	52.5	(78)
South	0.9x	0.54	x	5.57	x	40.4	x	0.4	x	0.7	=	30.62	(78)
South	0.9x	0.54	x	4.07	x	40.4	x	0.4	x	0.7	=	22.37	(78)
West	0.9x	0.54	x	5.77	x	19.64	x	0.4	x	0.7	=	15.42	(80)
West	0.9x	0.54	x	5.24	x	19.64	x	0.4	x	0.7	=	14	(80)
West	0.9x	0.54	x	5.77	x	38.42	x	0.4	x	0.7	=	30.17	(80)
West	0.9x	0.54	x	5.24	x	38.42	x	0.4	x	0.7	=	27.4	(80)
West	0.9x	0.54	x	5.77	x	63.27	x	0.4	x	0.7	=	49.68	(80)
West	0.9x	0.54	x	5.24	x	63.27	x	0.4	x	0.7	=	45.12	(80)
West	0.9x	0.54	x	5.77	x	92.28	x	0.4	x	0.7	=	72.46	(80)
West	0.9x	0.54	x	5.24	x	92.28	x	0.4	x	0.7	=	65.8	(80)
West	0.9x	0.54	x	5.77	x	113.09	x	0.4	x	0.7	=	88.8	(80)
West	0.9x	0.54	x	5.24	x	113.09	x	0.4	x	0.7	=	80.64	(80)
West	0.9x	0.54	x	5.77	x	115.77	x	0.4	x	0.7	=	90.9	(80)
West	0.9x	0.54	x	5.24	x	115.77	x	0.4	x	0.7	=	82.55	(80)
West	0.9x	0.54	x	5.77	x	110.22	x	0.4	x	0.7	=	86.54	(80)
West	0.9x	0.54	x	5.24	x	110.22	x	0.4	x	0.7	=	78.59	(80)
West	0.9x	0.54	x	5.77	x	94.68	x	0.4	x	0.7	=	74.34	(80)
West	0.9x	0.54	x	5.24	x	94.68	x	0.4	x	0.7	=	67.51	(80)
West	0.9x	0.54	x	5.77	x	73.59	x	0.4	x	0.7	=	57.78	(80)
West	0.9x	0.54	x	5.24	x	73.59	x	0.4	x	0.7	=	52.47	(80)

West	0.9x	0.54	x	5.77	x	45.59	x	0.4	x	0.7	=	35.8	(80)
West	0.9x	0.54	x	5.24	x	45.59	x	0.4	x	0.7	=	32.51	(80)
West	0.9x	0.54	x	5.77	x	24.49	x	0.4	x	0.7	=	19.23	(80)
West	0.9x	0.54	x	5.24	x	24.49	x	0.4	x	0.7	=	17.46	(80)
West	0.9x	0.54	x	5.77	x	16.15	x	0.4	x	0.7	=	12.68	(80)
West	0.9x	0.54	x	5.24	x	16.15	x	0.4	x	0.7	=	11.52	(80)

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

(83)m=	287.51	504.19	718.62	922.87	1051.91	1049.27	1009.77	914.75	790.62	565.93	347.23	244.06	(83)

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

(84)m=	778.47	992.82	1191.29	1369.68	1472.29	1444.28	1388.34	1300.08	1189.27	990.68	802	721.52	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.82	0.65	0.46	0.33	0.37	0.6	0.89	0.99	1	(86)

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

(87)m=	20.06	20.3	20.59	20.85	20.97	21	21	21	20.98	20.8	20.37	20.02	(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	20.09	20.09	20.1	20.09	20.08	20.08	20.07	(88)

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

(89)m=	0.99	0.97	0.92	0.78	0.59	0.4	0.26	0.3	0.52	0.86	0.98	1	(89)

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

(90)m=	18.82	19.18	19.58	19.93	20.05	20.09	20.09	20.1	20.08	19.87	19.28	18.77	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	19.06	19.39	19.78	20.1	20.23	20.26	20.27	20.27	20.25	20.05	19.49	19	(92)

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

(93)m=	19.06	19.39	19.78	20.1	20.23	20.26	20.27	20.27	20.25	20.05	19.49	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	0.97	0.91	0.78	0.6	0.41	0.28	0.31	0.54	0.85	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	770.97	962.29	1088.39	1074.27	881.78	591.12	383.92	403.79	638.2	846.37	782.11	716.67	(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=	1599.67	1566.47	1431.35	1192.18	905.28	593.34	384.11	404.14	647.8	1002.93	1321.96	1587.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	616.55	406.01	255.16	84.89	17.48	0	0	0	0	116.49	388.69	648.19	

DER WorkSheet: New dwelling design stage

	Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ =	2533.47	(98)
Space heating requirement in kWh/m²/year		23.87	(99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

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

Fraction of heat from Community boilers		1	(303a)
Fraction of total space heat from Community boilers	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2533.47	
Space heat from Community boilers	(98) x (304a) x (305) x (306) =	2786.81	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2314.53	
If DHW from community scheme: Water heat from Community boilers	(64) x (303a) x (305) x (306) =	2545.98	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	53.33	(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		267.07	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	267.07	(331)
Energy for lighting (calculated in Appendix L)		418.62	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				96	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0	=	1199.88	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	27.68	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	1227.56	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)

DER WorkSheet: New dwelling design stage

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) =			1227.56	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	138.61	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	217.27	(379)
Total CO2, kg/year	sum of (376)…(382) =			1583.43	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			14.92	(384)
EI rating (section 14)				85.96	(385)

Appendix C - Step Three – 'Clean' Output Document and Energy Report Figures

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: flat 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	57.7	(1a)	x	2.5	(2a)	=	144.25	(3a)
First floor	45.67	(1b)	x	2.5	(2b)	=	114.17	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	103.37	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	258.42	(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) = 77.35 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			3.69	x1/[1/(0.8)+ 0.04]		=	2.86			(27)
Windows Type 2			4.83	x1/[1/(0.8)+ 0.04]		=	3.74			(27)
Windows Type 3			3.01	x1/[1/(0.8)+ 0.04]		=	2.33			(27)
Windows Type 4			5.01	x1/[1/(0.8)+ 0.04]		=	3.88			(27)
Floor			57.7	x	0.13	=	7.501			(28)
Walls Type1	54.06	8.52	45.54	x	0.13	=	5.92			(29)
Walls Type2	48.74	8.02	40.72	x	0.13	=	5.29			(29)
Total area of elements, m²			162.61							(31)
Party wall			44.05	x	0	=	0			(32)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.74 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.2 (36) *if details of thermal bridging are not known (36) = 0.15 x (31)*

Total fabric heat loss (33) + (36) = 48.94 (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=	22.3	22.05	21.8	20.56	20.32	19.08	19.08	18.83	19.57	20.32	20.81	21.31	(38)

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

(39)m=	71.24	70.99	70.74	69.5	69.25	68.01	68.01	67.77	68.51	69.25	69.75	70.24	

Average = Sum(39)1…12 /12= 69.44 (39)

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

(40)m=	0.69	0.69	0.68	0.67	0.67	0.66	0.66	0.66	0.66	0.67	0.67	0.68	

Average = Sum(40)1…12 /12= 0.67 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.77 (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) + 36 105.22 (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=	115.74	111.53	107.32	103.11	98.9	94.69	94.69	98.9	103.11	107.32	111.53	115.74	

Total = Sum(44)1…12 = 1262.58 (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=	171.63	150.11	154.9	135.05	129.58	111.82	103.62	118.9	120.32	140.22	153.06	166.22	

Total = Sum(45)1…12 = 1655.45 (45)

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

(46)m=	25.75	22.52	23.24	20.26	19.44	16.77	15.54	17.84	18.05	21.03	22.96	24.93	(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=	226.91	200.04	210.18	188.54	184.86	165.31	158.89	174.18	173.82	195.5	206.56	221.5	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	226.91	200.04	210.18	188.54	184.86	165.31	158.89	174.18	173.82	195.5	206.56	221.5

Output from water heater (annual)$_{1...12}$ — 2306.29 (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=	101.29	89.85	95.73	87.7	87.31	79.97	78.67	83.76	82.8	90.85	93.69	99.49	(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=	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	138.43	(66)

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

(67)m=	25.03	22.23	18.08	13.69	10.23	8.64	9.33	12.13	16.28	20.67	24.13	25.72	(67)

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

(68)m=	261.66	264.38	257.54	242.97	224.58	207.3	195.76	193.04	199.88	214.45	232.84	250.12	(68)

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

(69)m=	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	(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=	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	-110.74	(71)

Water heating gains (Table 5)

(72)m=	136.14	133.71	128.66	121.8	117.35	111.08	105.74	112.58	115	122.1	130.12	133.72	(72)

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

(73)m=	487.36	484.85	468.81	442.99	416.69	391.54	375.36	382.27	395.7	421.76	451.62	474.09	(73)

6. Solar gains:

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

DER WorkSheet: New dwelling design stage

Orientation:		Access Factor Table 6d		Area m^2		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.69	x	10.63	x	0.4	x	0.7	=	7.61	(74)
North	0.9x	0.77	x	4.83	x	10.63	x	0.4	x	0.7	=	9.97	(74)
North	0.9x	0.77	x	3.01	x	10.63	x	0.4	x	0.7	=	6.21	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.4	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.69	x	20.32	x	0.4	x	0.7	=	14.55	(74)
North	0.9x	0.77	x	4.83	x	20.32	x	0.4	x	0.7	=	19.05	(74)
North	0.9x	0.77	x	3.01	x	20.32	x	0.4	x	0.7	=	11.87	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.4	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	3.69	x	34.53	x	0.4	x	0.7	=	24.72	(74)
North	0.9x	0.77	x	4.83	x	34.53	x	0.4	x	0.7	=	32.36	(74)
North	0.9x	0.77	x	3.01	x	34.53	x	0.4	x	0.7	=	20.17	(74)
North	0.9x	0.77	x	5.01	x	34.53	x	0.4	x	0.7	=	33.57	(74)
North	0.9x	0.77	x	3.69	x	55.46	x	0.4	x	0.7	=	39.71	(74)
North	0.9x	0.77	x	4.83	x	55.46	x	0.4	x	0.7	=	51.98	(74)
North	0.9x	0.77	x	3.01	x	55.46	x	0.4	x	0.7	=	32.39	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.4	x	0.7	=	53.92	(74)
North	0.9x	0.77	x	3.69	x	74.72	x	0.4	x	0.7	=	53.5	(74)
North	0.9x	0.77	x	4.83	x	74.72	x	0.4	x	0.7	=	70.02	(74)
North	0.9x	0.77	x	3.01	x	74.72	x	0.4	x	0.7	=	43.64	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.4	x	0.7	=	72.63	(74)
North	0.9x	0.77	x	3.69	x	79.99	x	0.4	x	0.7	=	57.27	(74)
North	0.9x	0.77	x	4.83	x	79.99	x	0.4	x	0.7	=	74.96	(74)
North	0.9x	0.77	x	3.01	x	79.99	x	0.4	x	0.7	=	46.72	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.4	x	0.7	=	77.76	(74)
North	0.9x	0.77	x	3.69	x	74.68	x	0.4	x	0.7	=	53.47	(74)
North	0.9x	0.77	x	4.83	x	74.68	x	0.4	x	0.7	=	69.99	(74)
North	0.9x	0.77	x	3.01	x	74.68	x	0.4	x	0.7	=	43.62	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.4	x	0.7	=	72.6	(74)
North	0.9x	0.77	x	3.69	x	59.25	x	0.4	x	0.7	=	42.42	(74)
North	0.9x	0.77	x	4.83	x	59.25	x	0.4	x	0.7	=	55.53	(74)
North	0.9x	0.77	x	3.01	x	59.25	x	0.4	x	0.7	=	34.6	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.4	x	0.7	=	57.6	(74)
North	0.9x	0.77	x	3.69	x	41.52	x	0.4	x	0.7	=	29.73	(74)
North	0.9x	0.77	x	4.83	x	41.52	x	0.4	x	0.7	=	38.91	(74)
North	0.9x	0.77	x	3.01	x	41.52	x	0.4	x	0.7	=	24.25	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.4	x	0.7	=	40.36	(74)
North	0.9x	0.77	x	3.69	x	24.19	x	0.4	x	0.7	=	17.32	(74)
North	0.9x	0.77	x	4.83	x	24.19	x	0.4	x	0.7	=	22.67	(74)
North	0.9x	0.77	x	3.01	x	24.19	x	0.4	x	0.7	=	14.13	(74)

North	0.9x	0.77	x	5.01	x	24.19	x	0.4	x	0.7	=	23.52	(74)
North	0.9x	0.77	x	3.69	x	13.12	x	0.4	x	0.7	=	9.39	(74)
North	0.9x	0.77	x	4.83	x	13.12	x	0.4	x	0.7	=	12.29	(74)
North	0.9x	0.77	x	3.01	x	13.12	x	0.4	x	0.7	=	7.66	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.4	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	3.69	x	8.86	x	0.4	x	0.7	=	6.35	(74)
North	0.9x	0.77	x	4.83	x	8.86	x	0.4	x	0.7	=	8.31	(74)
North	0.9x	0.77	x	3.01	x	8.86	x	0.4	x	0.7	=	5.18	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.4	x	0.7	=	8.62	(74)

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

(83)m=	34.13	65.22	110.82	178.01	239.79	256.71	239.67	190.15	133.24	77.63	42.1	28.45	(83)

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

(84)m=	521.49	550.07	579.63	621	656.48	648.25	615.03	572.42	528.94	499.39	493.72	502.54	(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	0.88	0.66	0.49	0.54	0.83	0.98	1	1	(86)

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

(87)m=	20.34	20.41	20.55	20.77	20.93	20.99	21	21	20.97	20.77	20.53	20.33	(87)

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

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

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

(89)m=	1	1	0.99	0.97	0.84	0.6	0.42	0.47	0.78	0.97	1	1	(89)

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

(90)m=	19.45	19.56	19.77	20.08	20.3	20.37	20.38	20.38	20.35	20.09	19.73	19.44	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.71	19.81	20	20.28	20.49	20.56	20.56	20.56	20.53	20.29	19.96	19.7	(92)

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

(93)m=	19.71	19.81	20	20.28	20.49	20.56	20.56	20.56	20.53	20.29	19.96	19.7	(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	0.96	0.85	0.62	0.44	0.49	0.79	0.97	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	520.61	548.39	574.84	598.56	558.81	401.52	269.11	281.49	419.27	486.09	491.68	501.9	(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=	1097.49	1058.13	954.76	790.83	608.41	405.04	269.31	281.96	440.43	671.04	897.26	1088.61	(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=	429.2	342.54	282.66	138.43	36.9	0	0	0	0	137.6	292.02	436.51

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2095.88 (98)

Space heating requirement in kWh/m²/year 20.28 (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		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(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		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2095.88	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1383.28	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	922.19	(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		2306.29	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1522.15	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1014.77	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	48.42	(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		315.28	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	315.28	(331)
Energy for lighting (calculated in Appendix L)		441.96	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		32	(361)

DER WorkSheet: New dwelling design stage

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Heat efficiency of CHP unit						64	(362)
Space heating from CHP)	(307a) × 100 ÷ (362) =	2161.38	x	0.22		466.86	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	691.64	x	0.52		-358.96	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2378.36	x	0.22		513.73	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	761.07	x	0.52		-395	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	435.81	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	25.13	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	687.57	(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) =					687.57	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	163.63	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	229.38	(379)
Total CO2, kg/year	sum of (376)...(382) =					1080.58	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					10.45	(384)
EI rating (section 14)						90.24	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.1.24

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.32	(1a) x	2.5	(2a) =	125.8	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.32	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	125.8	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.35	(23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			3.33	x1/[1/(0.8)+ 0.04]		=	2.58			(27)
Windows Type 2			5.01	x1/[1/(0.8)+ 0.04]		=	3.88			(27)
Walls	59.49	10.44	49.05	x	0.13	=	6.38			(29)
Total area of elements, m²			59.49							(31)
Party wall			17.5	x	0	=	0			(32)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	17.04	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		5.35	(36)

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

Total fabric heat loss	(33) + (36) =	22.39	(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=	10.85	10.73	10.61	10.01	9.89	9.29	9.29	9.17	9.53	9.89	10.13	10.37	(38)

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

(39)m=	33.25	33.13	33	32.4	32.28	31.68	31.68	31.56	31.92	32.28	32.52	32.76	

Average = Sum(39)$_{1…12}$ /12= 32.37 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.63	0.63	0.64	0.65	0.65

Average = Sum(40)$_{1…12}$ /12= 0.64 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.49 (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=	86.34	83.2	80.06	76.92	73.78	70.64	70.64	73.78	76.92	80.06	83.2	86.34

Total = Sum(44)$_{1…12}$ = 941.86 (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=	128.04	111.98	115.55	100.74	96.66	83.41	77.3	88.7	89.76	104.6	114.18	124

Total = Sum(45)$_{1…12}$ = 1234.92 (45)

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

(46)m=	19.21	16.8	17.33	15.11	14.5	12.51	11.59	13.3	13.46	15.69	17.13	18.6	(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)

DER WorkSheet: New dwelling design stage

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

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

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

(62)m=	183.31	161.91	170.83	154.24	151.94	136.91	132.57	143.97	143.25	159.88	167.68	179.27	(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=	183.31	161.91	170.83	154.24	151.94	136.91	132.57	143.97	143.25	159.88	167.68	179.27	

Output from water heater (annual)$_{1...12}$ 1885.76 (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=	86.79	77.18	82.64	76.29	76.36	70.53	69.92	73.71	72.64	79	80.76	85.45	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	14.05	12.48	10.15	7.69	5.74	4.85	5.24	6.81	9.14	11.61	13.55	14.44	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	148.07	149.6	145.73	137.49	127.08	117.3	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table 5)													
(72)m=	116.66	114.84	111.08	105.96	102.64	97.96	93.98	99.08	100.89	106.19	112.17	114.85	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	327.27	325.42	315.45	299.63	283.96	268.6	258.49	263.62	271.63	287.64	305.96	319.32	(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)	
North	0.9x	0.77	x	3.33	x	10.63	x	0.4	x	0.7	=	6.87	(74)
North	0.9x	0.77	x	5.01	x	10.63	x	0.4	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.33	x	20.32	x	0.4	x	0.7	=	13.13	(74)
North	0.9x	0.77	x	5.01	x	20.32	x	0.4	x	0.7	=	19.75	(74)
North	0.9x	0.77	x	3.33	x	34.53	x	0.4	x	0.7	=	22.31	(74)

North	0.9x	0.77	x	5.01	x	34.53	x	0.4	x	0.7	=	33.57	(74)
North	0.9x	0.77	x	3.33	x	55.46	x	0.4	x	0.7	=	35.84	(74)
North	0.9x	0.77	x	5.01	x	55.46	x	0.4	x	0.7	=	53.92	(74)
North	0.9x	0.77	x	3.33	x	74.72	x	0.4	x	0.7	=	48.28	(74)
North	0.9x	0.77	x	5.01	x	74.72	x	0.4	x	0.7	=	72.63	(74)
North	0.9x	0.77	x	3.33	x	79.99	x	0.4	x	0.7	=	51.68	(74)
North	0.9x	0.77	x	5.01	x	79.99	x	0.4	x	0.7	=	77.76	(74)
North	0.9x	0.77	x	3.33	x	74.68	x	0.4	x	0.7	=	48.25	(74)
North	0.9x	0.77	x	5.01	x	74.68	x	0.4	x	0.7	=	72.6	(74)
North	0.9x	0.77	x	3.33	x	59.25	x	0.4	x	0.7	=	38.28	(74)
North	0.9x	0.77	x	5.01	x	59.25	x	0.4	x	0.7	=	57.6	(74)
North	0.9x	0.77	x	3.33	x	41.52	x	0.4	x	0.7	=	26.83	(74)
North	0.9x	0.77	x	5.01	x	41.52	x	0.4	x	0.7	=	40.36	(74)
North	0.9x	0.77	x	3.33	x	24.19	x	0.4	x	0.7	=	15.63	(74)
North	0.9x	0.77	x	5.01	x	24.19	x	0.4	x	0.7	=	23.52	(74)
North	0.9x	0.77	x	3.33	x	13.12	x	0.4	x	0.7	=	8.48	(74)
North	0.9x	0.77	x	5.01	x	13.12	x	0.4	x	0.7	=	12.75	(74)
North	0.9x	0.77	x	3.33	x	8.86	x	0.4	x	0.7	=	5.73	(74)
North	0.9x	0.77	x	5.01	x	8.86	x	0.4	x	0.7	=	8.62	(74)

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

(83)m=	17.21	32.89	55.88	89.76	120.91	129.44	120.85	95.88	67.19	39.15	21.23	14.35	(83)

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

(84)m=	344.48	358.31	371.33	389.38	404.87	398.04	379.33	359.49	338.82	326.78	327.19	333.67	(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=	0.99	0.99	0.97	0.89	0.72	0.51	0.37	0.4	0.64	0.9	0.98	0.99	(86)

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

(87)m=	20.56	20.63	20.76	20.91	20.99	21	21	21	21	20.92	20.73	20.55	(87)

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

(88)m=	20.38	20.38	20.38	20.39	20.39	20.4	20.4	20.41	20.4	20.39	20.39	20.38	(88)

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

(89)m=	0.99	0.98	0.96	0.87	0.68	0.46	0.32	0.35	0.59	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=	19.79	19.9	20.07	20.29	20.38	20.4	20.4	20.41	20.4	20.3	20.05	19.78	(90)

fLA = Living area ÷ (4) = 0.48 (91)

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

(92)m=	20.16	20.25	20.4	20.59	20.67	20.69	20.69	20.69	20.68	20.6	20.37	20.15	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	20.16	20.25	20.4	20.59	20.67	20.69	20.69	20.69	20.68	20.6	20.37	20.15	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.88	0.7	0.48	0.34	0.38	0.62	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	340.44	351.66	356.24	342.03	284.08	192.67	129.55	135.39	208.62	289.49	318.24	330.44	(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=	527.4	508.44	458.81	378.7	289.58	192.9	129.57	135.42	210.16	322.74	431.71	522.66	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	139.09	105.35	76.31	26.41	4.09	0	0	0	0	24.74	81.7	143.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	600.7	(98)
Space heating requirement in kWh/m²/year	11.94	(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		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(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		1.1	(306)

Space heating		**kWh/year**	
Annual space heating requirement		600.7	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	396.46	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	264.31	(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		1885.76	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1244.6	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	829.74	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	27.35	(313)

DER WorkSheet: New dwelling design stage

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		136.21	(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) =	136.21	(331)
Energy for lighting (calculated in Appendix L)		248.2	(332)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Electrical efficiency of CHP unit						32	(361)
Heat efficiency of CHP unit						64	(362)
Space heating from CHP)	(307a) × 100 ÷ (362) =	619.47	x	0.22		133.81	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	198.23	x	0.52		-102.88	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	1944.69	x	0.22		420.05	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	622.3	x	0.52		-322.97	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	246.16	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	14.2	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	388.36	(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) =					388.36	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	70.69	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	128.81	(379)
Total CO2, kg/year	sum of (376)…(382) =					587.87	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					11.68	(384)
EI rating (section 14)						91.74	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	66.88	(1a) x	2.5	(2a) =	167.2	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	66.88	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	167.2	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

DER WorkSheet: New dwelling design stage

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

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 77.35 (23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			19.23	x1/[1/(0.8)+ 0.04]		=	14.91			(27)
Windows Type 2			9.5	x1/[1/(0.8)+ 0.04]		=	7.36			(27)
Windows Type 3			20.61	x1/[1/(0.8)+ 0.04]		=	15.98			(27)
Walls	95.5	51.44	44.06	x	0.13	=	5.73			(29)
Total area of elements, m²			95.5							(31)

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.18 (33)

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

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.1 (36)

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

Total fabric heat loss (33) + (36) = 56.28 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	14.43	14.27	14.11	13.3	13.14	12.34	12.34	12.18	12.66	13.14	13.46	13.79	(38)

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

(39)m=	70.7	70.54	70.38	69.58	69.42	68.62	68.62	68.46	68.94	69.42	69.74	70.06	

Average = Sum(39)$_{1…12}$ /12= 69.54 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	1.06	1.05	1.05	1.04	1.04	1.03	1.03	1.02	1.03	1.04	1.04	1.05

Average = Sum(40)$_{1...12}$ /12= 1.04 (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 2.17 (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 90.2 (43)

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

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

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

(44)m=	99.22	95.61	92.01	88.4	84.79	81.18	81.18	84.79	88.4	92.01	95.61	99.22

Total = Sum(44)$_{1...12}$ = 1082.42 (44)

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

(45)m=	147.14	128.69	132.8	115.78	111.09	95.86	88.83	101.94	103.15	120.21	131.22	142.5

Total = Sum(45)$_{1...12}$ = 1419.22 (45)

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

(46)m=	22.07	19.3	19.92	17.37	16.66	14.38	13.32	15.29	15.47	18.03	19.68	21.38	(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)

DER WorkSheet: New dwelling design stage

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

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

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

(62)m=	202.42	178.62	188.08	169.27	166.37	149.36	144.11	157.21	156.65	175.49	184.72	197.78	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

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

Output from water heater

(64)m=	202.42	178.62	188.08	169.27	166.37	149.36	144.11	157.21	156.65	175.49	184.72	197.78	

Output from water heater (annual)1…12 | 2070.06 | (64)

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

(65)m=	93.15	82.73	88.38	81.29	81.16	74.67	73.76	78.11	77.09	84.19	86.43	91.6	(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=	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	108.4	(66)

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

(67)m=	16.93	15.04	12.23	9.26	6.92	5.84	6.31	8.21	11.01	13.99	16.32	17.4	(67)

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

(68)m=	189.91	191.88	186.91	176.34	163	150.45	142.07	140.1	145.07	155.64	168.99	181.53	(68)

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

(69)m=	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	33.84	(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=	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	-86.72	(71)

Water heating gains (Table 5)

(72)m=	125.2	123.11	118.79	112.9	109.08	103.71	99.14	104.99	107.07	113.16	120.04	123.12	(72)

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

(73)m=	387.56	385.55	373.45	354.02	334.52	315.52	303.05	308.82	318.68	338.31	360.87	377.57	(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)	
East	0.9x	1	x	19.23	x	19.64	x	0.4	x	0.7	=	51.4	(76)
East	0.9x	1	x	19.23	x	38.42	x	0.4	x	0.7	=	100.54	(76)
East	0.9x	1	x	19.23	x	63.27	x	0.4	x	0.7	=	165.57	(76)
East	0.9x	1	x	19.23	x	92.28	x	0.4	x	0.7	=	241.48	(76)
East	0.9x	1	x	19.23	x	113.09	x	0.4	x	0.7	=	295.94	(76)

East	0.9x	1	x	19.23	x	115.77	x	0.4	x	0.7	=	302.95	(76)
East	0.9x	1	x	19.23	x	110.22	x	0.4	x	0.7	=	288.42	(76)
East	0.9x	1	x	19.23	x	94.68	x	0.4	x	0.7	=	247.75	(76)
East	0.9x	1	x	19.23	x	73.59	x	0.4	x	0.7	=	192.57	(76)
East	0.9x	1	x	19.23	x	45.59	x	0.4	x	0.7	=	119.3	(76)
East	0.9x	1	x	19.23	x	24.49	x	0.4	x	0.7	=	64.08	(76)
East	0.9x	1	x	19.23	x	16.15	x	0.4	x	0.7	=	42.26	(76)
South	0.9x	0.54	x	9.5	x	46.75	x	0.4	x	0.7	=	60.44	(78)
South	0.9x	0.54	x	9.5	x	76.57	x	0.4	x	0.7	=	98.98	(78)
South	0.9x	0.54	x	9.5	x	97.53	x	0.4	x	0.7	=	126.09	(78)
South	0.9x	0.54	x	9.5	x	110.23	x	0.4	x	0.7	=	142.51	(78)
South	0.9x	0.54	x	9.5	x	114.87	x	0.4	x	0.7	=	148.5	(78)
South	0.9x	0.54	x	9.5	x	110.55	x	0.4	x	0.7	=	142.91	(78)
South	0.9x	0.54	x	9.5	x	108.01	x	0.4	x	0.7	=	139.63	(78)
South	0.9x	0.54	x	9.5	x	104.89	x	0.4	x	0.7	=	135.6	(78)
South	0.9x	0.54	x	9.5	x	101.89	x	0.4	x	0.7	=	131.71	(78)
South	0.9x	0.54	x	9.5	x	82.59	x	0.4	x	0.7	=	106.76	(78)
South	0.9x	0.54	x	9.5	x	55.42	x	0.4	x	0.7	=	71.64	(78)
South	0.9x	0.54	x	9.5	x	40.4	x	0.4	x	0.7	=	52.23	(78)
West	0.9x	0.54	x	20.61	x	19.64	x	0.4	x	0.7	=	55.08	(80)
West	0.9x	0.54	x	20.61	x	38.42	x	0.4	x	0.7	=	107.75	(80)
West	0.9x	0.54	x	20.61	x	63.27	x	0.4	x	0.7	=	177.46	(80)
West	0.9x	0.54	x	20.61	x	92.28	x	0.4	x	0.7	=	258.81	(80)
West	0.9x	0.54	x	20.61	x	113.09	x	0.4	x	0.7	=	317.18	(80)
West	0.9x	0.54	x	20.61	x	115.77	x	0.4	x	0.7	=	324.69	(80)
West	0.9x	0.54	x	20.61	x	110.22	x	0.4	x	0.7	=	309.12	(80)
West	0.9x	0.54	x	20.61	x	94.68	x	0.4	x	0.7	=	265.53	(80)
West	0.9x	0.54	x	20.61	x	73.59	x	0.4	x	0.7	=	206.39	(80)
West	0.9x	0.54	x	20.61	x	45.59	x	0.4	x	0.7	=	127.86	(80)
West	0.9x	0.54	x	20.61	x	24.49	x	0.4	x	0.7	=	68.68	(80)
West	0.9x	0.54	x	20.61	x	16.15	x	0.4	x	0.7	=	45.3	(80)

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

(83)m=	166.92	307.28	469.12	642.8	761.62	770.55	737.17	648.88	530.67	353.92	204.41	139.79	(83)

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

(84)m=	554.47	692.83	842.57	996.82	1096.15	1086.08	1040.22	957.71	849.35	692.23	565.27	517.36	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.91	0.77	0.58	0.4	0.29	0.33	0.55	0.86	0.98	0.99	(86)

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

(87)m=	20.1	20.34	20.64	20.89	20.98	21	21	21	20.99	20.82	20.4	20.05	(87)

DER WorkSheet: New dwelling design stage

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

(88)m=	20.04	20.04	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04	(88)

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

(89)m=	0.99	0.96	0.89	0.72	0.52	0.34	0.23	0.26	0.48	0.82	0.97	0.99	(89)

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

(90)m=	18.85	19.2	19.62	19.93	20.03	20.06	20.06	20.06	20.05	19.87	19.3	18.79	(90)

fLA = Living area ÷ (4) = 0.56 (91)

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

(92)m=	19.55	19.84	20.19	20.47	20.56	20.59	20.59	20.59	20.58	20.4	19.92	19.5	(92)

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

(93)m=	19.55	19.84	20.19	20.47	20.56	20.59	20.59	20.59	20.58	20.4	19.92	19.5	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.89	0.74	0.55	0.38	0.26	0.3	0.52	0.84	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	546.84	666.24	753.59	740.37	603.47	409.52	273.48	286.45	440.1	580.01	547.16	512.14	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1078.33	1053.8	963.52	804.96	615.28	410.72	273.61	286.71	446.39	680.48	894.03	1071.8	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	395.43	260.44	156.19	46.51	8.79	0	0	0	0	74.75	249.75	416.38	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1608.23 (98)

Space heating requirement in kWh/m²/year 24.05 (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		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(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		1.1	(306)

Space heating	**kWh/year**
Annual space heating requirement	1608.23

DER WorkSheet: New dwelling design stage

Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1061.43	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	707.62	(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		2070.06	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1366.24	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	910.83	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	40.46	(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		234.58	(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) =	234.58	(331)
Energy for lighting (calculated in Appendix L)		299	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		32	(361)
Heat efficiency of CHP unit		64	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	1658.49	x	0.22		358.23	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	530.72	x	0.52		-275.44	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2134.75	x	0.22		461.11	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	683.12	x	0.52		-354.54	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	364.15	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	21	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	574.51	(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) =					574.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	121.75	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	155.18	(379)
Total CO2, kg/year	sum of (376)…(382) =					851.44	(383)

Dwelling CO2 Emission Rate	(383) ÷ (4) =	12.73	(384)
EI rating (section 14)		89.8	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.1.24

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	71.18	(1a) x	2.5	(2a) =	177.95	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	71.18	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	177.95	(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) =	77.35	(23c)

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

(24a)m=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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=	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	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			2.1	x	2	=	4.2			(26)
Windows Type 1			8.25	x1/[1/(0.8)+ 0.04]		=	6.4			(27)
Windows Type 2			15.71	x1/[1/(0.8)+ 0.04]		=	12.18			(27)
Walls	91.8	26.06	65.74	x	0.13	=	8.55			(29)
Roof	71.18	0	71.18	x	0.12	=	8.54			(30)
Total area of elements, m²			162.98							(31)

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	39.86	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		13.8	(36)

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

Total fabric heat loss	(33) + (36) =	53.66	(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=	15.35	15.18	15.01	14.16	13.99	13.14	13.14	12.97	13.48	13.99	14.33	14.67	(38)

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

(39)m=	69.02	68.85	68.67	67.82	67.65	66.8	66.8	66.63	67.14	67.65	67.99	68.33	

Average = $Sum(39)_{1…12}$ /12= 67.78 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	0.97	0.97	0.96	0.95	0.95	0.94	0.94	0.94	0.94	0.95	0.96	0.96

Average = Sum(40)$_{1...12}$ /12= 0.95 (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 2.27 (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 92.86 (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=	102.15	98.43	94.72	91	87.29	83.57	83.57	87.29	91	94.72	98.43	102.15	
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=	151.48	132.49	136.71	119.19	114.37	98.69	91.45	104.94	106.19	123.76	135.09	146.7	
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	22.72	19.87	20.51	17.88	17.15	14.8	13.72	15.74	15.93	18.56	20.26	22.01	(46)

Total = Sum(44)$_{1...12}$ = 1114.33 (44)

Total = Sum(45)$_{1...12}$ = 1461.06 (45)

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=	206.76	182.41	191.99	172.68	169.64	152.18	146.73	160.22	159.69	179.04	188.59	201.98	(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=	206.76	182.41	191.99	172.68	169.64	152.18	146.73	160.22	159.69	179.04	188.59	201.98	

Output from water heater (annual)1…12 | 2111.9 | (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=	94.59	83.99	89.68	82.43	82.25	75.61	74.63	79.11	78.1	85.37	87.71	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=	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	113.72	(66)

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

(67)m=	17.83	15.84	12.88	9.75	7.29	6.15	6.65	8.64	11.6	14.73	17.19	18.33	(67)

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

(68)m=	200.04	202.11	196.88	185.74	171.69	158.48	149.65	147.57	152.81	163.94	178	191.21	(68)

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

(69)m=	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	34.37	(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=	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	-90.98	(71)

Water heating gains (Table 5)

(72)m=	127.14	124.99	120.54	114.48	110.55	105.01	100.31	106.34	108.48	114.75	121.82	125	(72)

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

(73)m=	402.12	400.06	387.41	367.09	346.64	326.76	313.72	319.67	330	350.53	374.13	391.65	(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)	
North	0.9x	0.54	x	15.71	x	10.63	x	0.4	x	0.7	=	22.73	(74)
North	0.9x	0.54	x	15.71	x	20.32	x	0.4	x	0.7	=	43.44	(74)
North	0.9x	0.54	x	15.71	x	34.53	x	0.4	x	0.7	=	73.82	(74)
North	0.9x	0.54	x	15.71	x	55.46	x	0.4	x	0.7	=	118.57	(74)
North	0.9x	0.54	x	15.71	x	74.72	x	0.4	x	0.7	=	159.73	(74)

North	0.9x	0.54	x	15.71	x	79.99	x	0.4	x	0.7	=	170.99	(74)
North	0.9x	0.54	x	15.71	x	74.68	x	0.4	x	0.7	=	159.64	(74)
North	0.9x	0.54	x	15.71	x	59.25	x	0.4	x	0.7	=	126.66	(74)
North	0.9x	0.54	x	15.71	x	41.52	x	0.4	x	0.7	=	88.75	(74)
North	0.9x	0.54	x	15.71	x	24.19	x	0.4	x	0.7	=	51.71	(74)
North	0.9x	0.54	x	15.71	x	13.12	x	0.4	x	0.7	=	28.04	(74)
North	0.9x	0.54	x	15.71	x	8.86	x	0.4	x	0.7	=	18.95	(74)
West	0.9x	0.54	x	8.25	x	19.64	x	0.4	x	0.7	=	22.05	(80)
West	0.9x	0.54	x	8.25	x	38.42	x	0.4	x	0.7	=	43.13	(80)
West	0.9x	0.54	x	8.25	x	63.27	x	0.4	x	0.7	=	71.03	(80)
West	0.9x	0.54	x	8.25	x	92.28	x	0.4	x	0.7	=	103.6	(80)
West	0.9x	0.54	x	8.25	x	113.09	x	0.4	x	0.7	=	126.96	(80)
West	0.9x	0.54	x	8.25	x	115.77	x	0.4	x	0.7	=	129.97	(80)
West	0.9x	0.54	x	8.25	x	110.22	x	0.4	x	0.7	=	123.74	(80)
West	0.9x	0.54	x	8.25	x	94.68	x	0.4	x	0.7	=	106.29	(80)
West	0.9x	0.54	x	8.25	x	73.59	x	0.4	x	0.7	=	82.62	(80)
West	0.9x	0.54	x	8.25	x	45.59	x	0.4	x	0.7	=	51.18	(80)
West	0.9x	0.54	x	8.25	x	24.49	x	0.4	x	0.7	=	27.49	(80)
West	0.9x	0.54	x	8.25	x	16.15	x	0.4	x	0.7	=	18.13	(80)

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

(83)m=	44.78	86.58	144.85	222.17	286.69	300.96	283.38	232.95	171.37	102.89	55.54	37.08	(83)

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

(84)m=	446.9	486.63	532.27	589.27	633.34	627.72	597.11	552.62	501.37	453.43	429.67	428.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.85	0.66	0.49	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=	20.04	20.15	20.36	20.65	20.88	20.98	21	20.99	20.93	20.64	20.29	20.02	(87)

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

(88)m=	20.11	20.11	20.11	20.12	20.12	20.13	20.13	20.14	20.13	20.12	20.12	20.12	(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	0.58	0.39	0.45	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=	18.82	18.98	19.29	19.71	20.01	20.12	20.13	20.13	20.07	19.7	19.2	18.8	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	19.22	19.37	19.64	20.02	20.29	20.41	20.42	20.42	20.36	20.01	19.56	19.2	(92)

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

(93)m=	19.22	19.37	19.64	20.02	20.29	20.41	20.42	20.42	20.36	20.01	19.56	19.2	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.82	0.6	0.43	0.48	0.77	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	444.86	482.66	521.77	552.04	516.52	379.01	254.24	265.96	386.14	433.76	425.63	427.17	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1029.9	996.22	902.68	754.08	581.44	387.84	255.19	267.84	420.1	636.93	847.41	1025.04	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	435.27	345.11	283.4	145.46	48.3	0	0	0	0	151.16	303.68	444.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2157.19 (98)

Space heating requirement in kWh/m²/year 30.31 (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		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(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		1.1	(306)

Space heating		**kWh/year**	
Annual space heating requirement		2157.19	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1423.75	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	949.17	(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		2111.9	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1393.85	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	929.24	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	46.96	(313)

DER WorkSheet: New dwelling design stage

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		249.66	(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) =	249.66	(331)
Energy for lighting (calculated in Appendix L)		314.94	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		32	(361)
Heat efficiency of CHP unit		64	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2224.61	x	0.22		480.52	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	711.87	x	0.52		-369.46	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2177.9	x	0.22		470.43	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	696.93	x	0.52		-361.71	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	422.64	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	24.37	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	666.79	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					666.79	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	129.58	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	163.45	(379)
Total CO2, kg/year	sum of (376)…(382) =					959.82	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					13.48	(384)
EI rating (section 14)						88.93	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.1.24

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	42.57	(1a) x	2.5	(2a) =	106.42	(3a)
First floor	32.51	(1b) x	2.5	(2b) =	81.27	(3b)
Second floor	31.06	(1c) x	2.5	(2c) =	77.65	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	106.14	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		265.35	(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)

DRAFT

			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) =	63.7	(23c)

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

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

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

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

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

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

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

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.34	0.32	0.32	0.3	0.3	0.3	0.31	0.32	0.32	0.33	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.1	x	2	=	4.2			(26)
Windows Type 1			6.21	x1/[1/(0.8)+ 0.04]		=	4.81			(27)
Windows Type 2			9.55	x1/[1/(0.8)+ 0.04]		=	7.4			(27)
Windows Type 3			9.82	x1/[1/(0.8)+ 0.04]		=	7.61			(27)
Windows Type 4			5.77	x1/[1/(0.8)+ 0.04]		=	4.47			(27)
Windows Type 5			9.55	x1/[1/(0.8)+ 0.04]		=	7.4			(27)
Windows Type 6			6.5	x1/[1/(0.8)+ 0.04]		=	5.04			(27)
Windows Type 7			5.24	x1/[1/(0.8)+ 0.04]		=	4.06			(27)
Windows Type 8			5.57	x1/[1/(0.8)+ 0.04]		=	4.32			(27)
Windows Type 9			4.07	x1/[1/(0.8)+ 0.04]		=	3.16			(27)
Windows Type 10			5.62	x1/[1/(0.8)+ 0.04]		=	4.36			(27)
Walls Type1	40.22	25.58	14.64	x	0.13	=	1.9			(29)
Walls Type2	39.17	21.82	17.35	x	0.13	=	2.26			(29)
Walls Type3	39.17	20.5	18.67	x	0.13	=	2.43			(29)
Roof	31.06	0	31.06	x	0.12	=	3.73			(30)
Total area of elements, m²			151.71							(31)
Party wall			63.1	x	0	=	0			(32)

DER WorkSheet: New dwelling design stage

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	67.15	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		11.1	(36)

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

Total fabric heat loss	(33) + (36) =	78.25	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.13	29.85	29.57	28.17	27.9	26.5	26.5	26.22	27.06	27.9	28.45	29.01	(38)

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

(39)m=	108.38	108.1	107.82	106.42	106.14	104.75	104.75	104.47	105.31	106.14	106.7	107.26

Average = Sum(39)$_{1…12}$ /12= 106.35 (39)

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

(40)m=	1.02	1.02	1.02	1	1	0.99	0.99	0.98	0.99	1	1.01	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	2.79	(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	105.74	(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=	116.31	112.08	107.85	103.62	99.39	95.17	95.17	99.39	103.62	107.85	112.08	116.31

Total = Sum(44)$_{1…12}$ = 1268.87 (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=	172.49	150.86	155.67	135.72	130.23	112.38	104.13	119.49	120.92	140.92	153.83	167.05

Total = Sum(45)$_{1…12}$ = 1663.69 (45)

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

(46)m=	25.87	22.63	23.35	20.36	19.53	16.86	15.62	17.92	18.14	21.14	23.07	25.06	(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=	227.77	200.79	210.95	189.21	185.5	165.87	159.41	174.77	174.41	196.2	207.32	222.32	(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=	227.77	200.79	210.95	189.21	185.5	165.87	159.41	174.77	174.41	196.2	207.32	222.32

Output from water heater (annual)$_{1\ldots12}$ 2314.53 (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=	101.57	90.1	95.98	87.92	87.52	80.16	78.85	83.95	83	91.08	93.94	99.76	(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=	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	139.48	(66)

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

(67)m=	23.7	21.05	17.12	12.96	9.69	8.18	8.84	11.49	15.42	19.58	22.85	24.36	(67)

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

(68)m=	265.89	268.65	261.7	246.89	228.21	210.65	198.92	196.16	203.11	217.91	236.6	254.16	(68)

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

(69)m=	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	36.95	(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=	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	-111.58	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	136.52	134.08	129.01	122.11	117.64	111.33	105.98	112.84	115.28	122.42	130.48	134.09	(72)

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

(73)m=	490.96	488.63	472.67	446.81	420.38	395.01	378.57	385.33	398.65	424.75	454.77	477.46	(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)	
East	0.9x	1	x	6.21	x	19.64	x	0.4	x	0.7	=	16.6	(76)
East	0.9x	1	x	9.82	x	19.64	x	0.4	x	0.7	=	26.25	(76)
East	0.9x	1	x	6.5	x	19.64	x	0.4	x	0.7	=	17.37	(76)
East	0.9x	1	x	5.62	x	19.64	x	0.4	x	0.7	=	15.02	(76)
East	0.9x	1	x	6.21	x	38.42	x	0.4	x	0.7	=	32.47	(76)
East	0.9x	1	x	9.82	x	38.42	x	0.4	x	0.7	=	51.34	(76)
East	0.9x	1	x	6.5	x	38.42	x	0.4	x	0.7	=	33.98	(76)
East	0.9x	1	x	5.62	x	38.42	x	0.4	x	0.7	=	29.38	(76)
East	0.9x	1	x	6.21	x	63.27	x	0.4	x	0.7	=	53.47	(76)
East	0.9x	1	x	9.82	x	63.27	x	0.4	x	0.7	=	84.55	(76)
East	0.9x	1	x	6.5	x	63.27	x	0.4	x	0.7	=	55.97	(76)
East	0.9x	1	x	5.62	x	63.27	x	0.4	x	0.7	=	48.39	(76)
East	0.9x	1	x	6.21	x	92.28	x	0.4	x	0.7	=	77.98	(76)
East	0.9x	1	x	9.82	x	92.28	x	0.4	x	0.7	=	123.31	(76)
East	0.9x	1	x	6.5	x	92.28	x	0.4	x	0.7	=	81.62	(76)
East	0.9x	1	x	5.62	x	92.28	x	0.4	x	0.7	=	70.57	(76)
East	0.9x	1	x	6.21	x	113.09	x	0.4	x	0.7	=	95.57	(76)
East	0.9x	1	x	9.82	x	113.09	x	0.4	x	0.7	=	151.13	(76)
East	0.9x	1	x	6.5	x	113.09	x	0.4	x	0.7	=	100.03	(76)
East	0.9x	1	x	5.62	x	113.09	x	0.4	x	0.7	=	86.49	(76)
East	0.9x	1	x	6.21	x	115.77	x	0.4	x	0.7	=	97.83	(76)
East	0.9x	1	x	9.82	x	115.77	x	0.4	x	0.7	=	154.7	(76)
East	0.9x	1	x	6.5	x	115.77	x	0.4	x	0.7	=	102.4	(76)
East	0.9x	1	x	5.62	x	115.77	x	0.4	x	0.7	=	88.54	(76)
East	0.9x	1	x	6.21	x	110.22	x	0.4	x	0.7	=	93.14	(76)
East	0.9x	1	x	9.82	x	110.22	x	0.4	x	0.7	=	147.29	(76)
East	0.9x	1	x	6.5	x	110.22	x	0.4	x	0.7	=	97.49	(76)
East	0.9x	1	x	5.62	x	110.22	x	0.4	x	0.7	=	84.29	(76)
East	0.9x	1	x	6.21	x	94.68	x	0.4	x	0.7	=	80.01	(76)
East	0.9x	1	x	9.82	x	94.68	x	0.4	x	0.7	=	126.52	(76)
East	0.9x	1	x	6.5	x	94.68	x	0.4	x	0.7	=	83.74	(76)
East	0.9x	1	x	5.62	x	94.68	x	0.4	x	0.7	=	72.41	(76)

East	0.9x	1	x	6.21	x	73.59	x	0.4	x	0.7	=	62.19	(76)
East	0.9x	1	x	9.82	x	73.59	x	0.4	x	0.7	=	98.34	(76)
East	0.9x	1	x	6.5	x	73.59	x	0.4	x	0.7	=	65.09	(76)
East	0.9x	1	x	5.62	x	73.59	x	0.4	x	0.7	=	56.28	(76)
East	0.9x	1	x	6.21	x	45.59	x	0.4	x	0.7	=	38.53	(76)
East	0.9x	1	x	9.82	x	45.59	x	0.4	x	0.7	=	60.92	(76)
East	0.9x	1	x	6.5	x	45.59	x	0.4	x	0.7	=	40.32	(76)
East	0.9x	1	x	5.62	x	45.59	x	0.4	x	0.7	=	34.87	(76)
East	0.9x	1	x	6.21	x	24.49	x	0.4	x	0.7	=	20.69	(76)
East	0.9x	1	x	9.82	x	24.49	x	0.4	x	0.7	=	32.72	(76)
East	0.9x	1	x	6.5	x	24.49	x	0.4	x	0.7	=	21.66	(76)
East	0.9x	1	x	5.62	x	24.49	x	0.4	x	0.7	=	18.73	(76)
East	0.9x	1	x	6.21	x	16.15	x	0.4	x	0.7	=	13.65	(76)
East	0.9x	1	x	9.82	x	16.15	x	0.4	x	0.7	=	21.58	(76)
East	0.9x	1	x	6.5	x	16.15	x	0.4	x	0.7	=	14.29	(76)
East	0.9x	1	x	5.62	x	16.15	x	0.4	x	0.7	=	12.35	(76)
South	0.9x	0.54	x	9.55	x	46.75	x	0.4	x	0.7	=	60.76	(78)
South	0.9x	0.54	x	9.55	x	46.75	x	0.4	x	0.7	=	60.76	(78)
South	0.9x	0.54	x	5.57	x	46.75	x	0.4	x	0.7	=	35.44	(78)
South	0.9x	0.54	x	4.07	x	46.75	x	0.4	x	0.7	=	25.89	(78)
South	0.9x	0.54	x	9.55	x	76.57	x	0.4	x	0.7	=	99.5	(78)
South	0.9x	0.54	x	9.55	x	76.57	x	0.4	x	0.7	=	99.5	(78)
South	0.9x	0.54	x	5.57	x	76.57	x	0.4	x	0.7	=	58.04	(78)
South	0.9x	0.54	x	4.07	x	76.57	x	0.4	x	0.7	=	42.41	(78)
South	0.9x	0.54	x	9.55	x	97.53	x	0.4	x	0.7	=	126.75	(78)
South	0.9x	0.54	x	9.55	x	97.53	x	0.4	x	0.7	=	126.75	(78)
South	0.9x	0.54	x	5.57	x	97.53	x	0.4	x	0.7	=	73.93	(78)
South	0.9x	0.54	x	4.07	x	97.53	x	0.4	x	0.7	=	54.02	(78)
South	0.9x	0.54	x	9.55	x	110.23	x	0.4	x	0.7	=	143.26	(78)
South	0.9x	0.54	x	9.55	x	110.23	x	0.4	x	0.7	=	143.26	(78)
South	0.9x	0.54	x	5.57	x	110.23	x	0.4	x	0.7	=	83.55	(78)
South	0.9x	0.54	x	4.07	x	110.23	x	0.4	x	0.7	=	61.05	(78)
South	0.9x	0.54	x	9.55	x	114.87	x	0.4	x	0.7	=	149.28	(78)
South	0.9x	0.54	x	9.55	x	114.87	x	0.4	x	0.7	=	149.28	(78)
South	0.9x	0.54	x	5.57	x	114.87	x	0.4	x	0.7	=	87.07	(78)
South	0.9x	0.54	x	4.07	x	114.87	x	0.4	x	0.7	=	63.62	(78)
South	0.9x	0.54	x	9.55	x	110.55	x	0.4	x	0.7	=	143.66	(78)
South	0.9x	0.54	x	9.55	x	110.55	x	0.4	x	0.7	=	143.66	(78)
South	0.9x	0.54	x	5.57	x	110.55	x	0.4	x	0.7	=	83.79	(78)
South	0.9x	0.54	x	4.07	x	110.55	x	0.4	x	0.7	=	61.23	(78)
South	0.9x	0.54	x	9.55	x	108.01	x	0.4	x	0.7	=	140.37	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.54	x	9.55	x	108.01	x	0.4	x	0.7	=	140.37	(78)
South	0.9x	0.54	x	5.57	x	108.01	x	0.4	x	0.7	=	81.87	(78)
South	0.9x	0.54	x	4.07	x	108.01	x	0.4	x	0.7	=	59.82	(78)
South	0.9x	0.54	x	9.55	x	104.89	x	0.4	x	0.7	=	136.32	(78)
South	0.9x	0.54	x	9.55	x	104.89	x	0.4	x	0.7	=	136.32	(78)
South	0.9x	0.54	x	5.57	x	104.89	x	0.4	x	0.7	=	79.51	(78)
South	0.9x	0.54	x	4.07	x	104.89	x	0.4	x	0.7	=	58.1	(78)
South	0.9x	0.54	x	9.55	x	101.89	x	0.4	x	0.7	=	132.41	(78)
South	0.9x	0.54	x	9.55	x	101.89	x	0.4	x	0.7	=	132.41	(78)
South	0.9x	0.54	x	5.57	x	101.89	x	0.4	x	0.7	=	77.23	(78)
South	0.9x	0.54	x	4.07	x	101.89	x	0.4	x	0.7	=	56.43	(78)
South	0.9x	0.54	x	9.55	x	82.59	x	0.4	x	0.7	=	107.33	(78)
South	0.9x	0.54	x	9.55	x	82.59	x	0.4	x	0.7	=	107.33	(78)
South	0.9x	0.54	x	5.57	x	82.59	x	0.4	x	0.7	=	62.6	(78)
South	0.9x	0.54	x	4.07	x	82.59	x	0.4	x	0.7	=	45.74	(78)
South	0.9x	0.54	x	9.55	x	55.42	x	0.4	x	0.7	=	72.02	(78)
South	0.9x	0.54	x	9.55	x	55.42	x	0.4	x	0.7	=	72.02	(78)
South	0.9x	0.54	x	5.57	x	55.42	x	0.4	x	0.7	=	42	(78)
South	0.9x	0.54	x	4.07	x	55.42	x	0.4	x	0.7	=	30.69	(78)
South	0.9x	0.54	x	9.55	x	40.4	x	0.4	x	0.7	=	52.5	(78)
South	0.9x	0.54	x	9.55	x	40.4	x	0.4	x	0.7	=	52.5	(78)
South	0.9x	0.54	x	5.57	x	40.4	x	0.4	x	0.7	=	30.62	(78)
South	0.9x	0.54	x	4.07	x	40.4	x	0.4	x	0.7	=	22.37	(78)
West	0.9x	0.54	x	5.77	x	19.64	x	0.4	x	0.7	=	15.42	(80)
West	0.9x	0.54	x	5.24	x	19.64	x	0.4	x	0.7	=	14	(80)
West	0.9x	0.54	x	5.77	x	38.42	x	0.4	x	0.7	=	30.17	(80)
West	0.9x	0.54	x	5.24	x	38.42	x	0.4	x	0.7	=	27.4	(80)
West	0.9x	0.54	x	5.77	x	63.27	x	0.4	x	0.7	=	49.68	(80)
West	0.9x	0.54	x	5.24	x	63.27	x	0.4	x	0.7	=	45.12	(80)
West	0.9x	0.54	x	5.77	x	92.28	x	0.4	x	0.7	=	72.46	(80)
West	0.9x	0.54	x	5.24	x	92.28	x	0.4	x	0.7	=	65.8	(80)
West	0.9x	0.54	x	5.77	x	113.09	x	0.4	x	0.7	=	88.8	(80)
West	0.9x	0.54	x	5.24	x	113.09	x	0.4	x	0.7	=	80.64	(80)
West	0.9x	0.54	x	5.77	x	115.77	x	0.4	x	0.7	=	90.9	(80)
West	0.9x	0.54	x	5.24	x	115.77	x	0.4	x	0.7	=	82.55	(80)
West	0.9x	0.54	x	5.77	x	110.22	x	0.4	x	0.7	=	86.54	(80)
West	0.9x	0.54	x	5.24	x	110.22	x	0.4	x	0.7	=	78.59	(80)
West	0.9x	0.54	x	5.77	x	94.68	x	0.4	x	0.7	=	74.34	(80)
West	0.9x	0.54	x	5.24	x	94.68	x	0.4	x	0.7	=	67.51	(80)
West	0.9x	0.54	x	5.77	x	73.59	x	0.4	x	0.7	=	57.78	(80)
West	0.9x	0.54	x	5.24	x	73.59	x	0.4	x	0.7	=	52.47	(80)

DER WorkSheet: New dwelling design stage

West	0.9x	0.54	x	5.77	x	45.59	x	0.4	x	0.7	=	35.8	(80)
West	0.9x	0.54	x	5.24	x	45.59	x	0.4	x	0.7	=	32.51	(80)
West	0.9x	0.54	x	5.77	x	24.49	x	0.4	x	0.7	=	19.23	(80)
West	0.9x	0.54	x	5.24	x	24.49	x	0.4	x	0.7	=	17.46	(80)
West	0.9x	0.54	x	5.77	x	16.15	x	0.4	x	0.7	=	12.68	(80)
West	0.9x	0.54	x	5.24	x	16.15	x	0.4	x	0.7	=	11.52	(80)

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

(83)m=	287.51	504.19	718.62	922.87	1051.91	1049.27	1009.77	914.75	790.62	565.93	347.23	244.06	(83)

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

(84)m=	778.47	992.82	1191.29	1369.68	1472.29	1444.28	1388.34	1300.08	1189.27	990.68	802	721.52	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.94	0.82	0.65	0.46	0.33	0.37	0.6	0.89	0.99	1	(86)

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

(87)m=	20.06	20.3	20.59	20.85	20.97	21	21	21	20.98	20.8	20.37	20.02	(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	20.09	20.09	20.1	20.09	20.08	20.08	20.07	(88)

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

(89)m=	0.99	0.97	0.92	0.78	0.59	0.4	0.26	0.3	0.52	0.86	0.98	1	(89)

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

(90)m=	18.82	19.18	19.58	19.93	20.05	20.09	20.09	20.1	20.08	19.87	19.28	18.77	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	19.06	19.39	19.78	20.1	20.23	20.26	20.27	20.27	20.25	20.05	19.49	19	(92)

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

(93)m=	19.06	19.39	19.78	20.1	20.23	20.26	20.27	20.27	20.25	20.05	19.49	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	0.97	0.91	0.78	0.6	0.41	0.28	0.31	0.54	0.85	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	770.97	962.29	1088.39	1074.27	881.78	591.12	383.92	403.79	638.2	846.37	782.11	716.67	(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=	1599.67	1566.47	1431.35	1192.18	905.28	593.34	384.11	404.14	647.8	1002.93	1321.96	1587.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	616.55	406.01	255.16	84.89	17.48	0	0	0	0	116.49	388.69	648.19	

DER WorkSheet: New dwelling design stage

	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	2533.47	(98)
Space heating requirement in kWh/m²/year		23.87	(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		0.6	(303a)
Fraction of community heat from heat source 2		0.4	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.6	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.4	(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		1.1	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2533.47	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	1672.09	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	1114.73	(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		2314.53	
If DHW from community scheme:			
Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1527.59	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	1018.39	(310b)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	53.33	(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		267.07	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	267.07	(331)
Energy for lighting (calculated in Appendix L)		418.62	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		32	(361)
Heat efficiency of CHP unit		64	(362)

DER WorkSheet: New dwelling design stage

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	2612.64	x	0.22		564.33	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	836.04	x	0.52		-433.91	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	2386.86	x	0.22		515.56	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	763.79	x	0.52		-396.41	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					96	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	479.95	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	27.68	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)				=	757.2	(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) =					757.2	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	138.61	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	217.27	(379)
Total CO2, kg/year	sum of (376)…(382) =					1113.08	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					10.49	(384)
EI rating (section 14)						90.13	(385)

Appendix D - Renewable Technologies; Description, Benefits and Limitations

Domestic Solar Hot Water Heating

Solar thermal or solar hot water (SHW) systems use a collector which is generally mounted on the roof, and typically contains a water glycol mixture which is heated by the sun. The heated liquid is then passed through a coil in a hot water storage cylinder. The water in the cylinder is then further heated (if required) by a boiler or electric immersion heater. The free energy obtained from the sun can be used to offset the amount of energy required for providing domestic hot water, and will reduce both running costs (due to the fuel being displaced electricity, natural gas, Liquefied Petroleum Gas (LPG) or oil) and the associated CO_2 emissions.

These systems are not good enough to provide space heating in the UK due to the climate but are among the most cost-effective renewable energy systems that can be installed to assist with domestic hot water demand.

Solar water heating could be installed by utilising either evacuated tube type panels or flat plate collectors mounted on the roof of the building.

Reasons for Excluding this Technology for this Site

SHW only contributes to the water heating demand of the property and has reduced effectiveness during the winter months. Consequently they do not supply sufficient carbon reduction. This technology is not considered suitable for this project and is not investigated further.

The technology cannot produce a material contribution to the energy needs of a commercial development such as this, as the demand for hot water is for occasional hand washing which represents a very small proportion of the total demand. It is quite possible that the energy consumed by the solar circuit pump would be greater than the energy used by instantaneous water heaters to provide the same amount of hot water. For these reasons solar thermal panels are only suitable for specific commercial applications which have a quantifiable demand for hot water that can be matched to the output characteristic of a solar thermal system.

Photovoltaic Panels (PV)

PV systems convert energy from the sun into electricity through semi-conductor cells. A cell consists of two thin layers of different semi-conducting materials, usually based on silicon. When light shines on the cell, a difference in energy is created – otherwise known as voltage. This voltage is used to produce a direct current (DC), which can be used directly or converted into alternating current (AC). AC can be exported to the local electricity network/national grid. The brighter the sunlight, the more power is produced. Shading from other objects (such as nearby buildings and trees) will affect performance and PV cells are more likely to show a drop in output than solar thermal panels. As with solar hot water, the panels should face as close to due south as possible and be unshaded for most of the day. An individual PV cell only produces a small amount of power, therefore they are usually connected together to form a module. Modules can then be linked to form an array and sized to meet the required demand.

The size of a Photovoltaic (PV) installation is expressed by its kilowatt peak (kWp) potential, which is an indication of how much electricity the system could generate at peak/optimum conditions. The electricity generated on-site by Photovoltaic cells would be a direct saving on electricity otherwise sourced from the national grid. The electricity generated would be a direct saving on electricity required for power, lighting, heating and hot water (depending on systems installed). Whilst expensive it should be noted that PV technology off-sets three times the carbon dioxide from grid supplied electricity compared to technology which reduces natural gas consumption therefore as a single simplistic solution it compares favourably.

Reasons for Excluding this Technology for this Site

The proposed development does not allow sufficient roof space to implement such technology. This technology is not considered suitable for this project and is not investigated further.

Biomass Boilers

Biomass heating is the combustion of a biomass fuel such as wood in a boiler to supply space heating and hot water. Biomass fuel is biological in origin and, when from sustainable sources, is regarded as renewable.

The most common fuel is wood, supplied in three forms; logs, chips and compressed wood pellets.

Any biomass heating system requires the following main components:

- Fuel storage;
- One or more boilers;
- One or more heat accumulators;
- A chimney stack or flue;
- A heat meter.

Sufficient fuel must be stored on-site to maintain operations in between deliveries. The amount will depend on circumstances, but is typically not less than a week of operation at full load.

The store must keep the fuel dry. Wet fuel will cause the boiler to malfunction.
The design of the store will depend on the fuel selected; logs can be kept in a simple shed, chips in a storage bay and pellets in an enclosed hopper. Typical solutions are silos similar to animal feed storage or partitioned sections in an enclosed barn, outhouse or commodity store.

Access is needed for deliveries and some is needed to convey the fuel to the boiler on demand.

There are two main types of boiler – continuously fuelled and batch fuelled. Continuously fuelled boilers use wood chip or pellet fuels and can be made fully automatic.

The space requirement for biomass plant, equipment and associated fuel storage is significant and given the footprint of the building and its central London location the site has limited off-street loading and delivery areas. Biomass requires frequent and regular deliveries of fuel which would impact on local transportation due to site servicing constraints and would therefore not be suitable for this redevelopment.

Reasons for Excluding this Technology for this Site

There are many discussions at this time with regards to the suitability of biomass within the GLA region due to the Clean Air Act Requirements and the viability of clean biomass systems has not yet been proven.

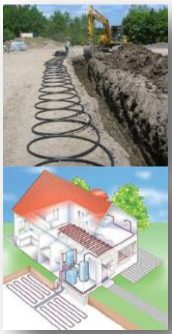
Therefore the inclusion of biomass has not been deemed appropriate and is not considered further.

Storage limitations dictate whether it is physically feasible to include within the development's renewable energy strategy; a large dry space for storing the fuel would be required to hold several months' worth of fuel. In addition, a fuel supplier would need to be within reasonable vicinity; otherwise the emissions associated with delivery will significantly reduce the on-site carbon savings.

Biomass boilers do not operate in the same way as gas and oil boilers. They have a more limited operating range and cannot respond as rapidly to changes in demand. Short operating cycles are not recommended. The use of a hot water tank or accumulator in the system to balance the output of the boiler and the demand of the heating system is highly recommended. The necessary volume depends on the type of boiler and the character of the heating system. Pellet boilers have a good operating range and a relatively small tank would be used. Log boilers have little range and a large tank that can absorb the energy contained within one or more charges of wood is necessary.

Biomass boilers are combustion appliances and are subject to regulation on placing height and the quantity of pollutant emissions. This should be discussed with the Environmental Health Officer of the Local Authority.

Ground Source Heat Pumps



Ground source heat pumps can be used to provide heating and or cooling to the building. Whilst ground source does rely on fossil fuels (indirectly) to provide the energy source, they are considered renewable given their high coefficient of performance and hence reduced fossil fuel reliance.

This can be one of four methods:

1 Closed horizontal loops, generally comprising a number of flow and return horizontal coiled loops sometimes called 'slinkies'.

2 Closed vertical loops, generally comprising a number of flow and return vertical loops to approximately 100m.

3 Open loop, generally comprising of an abstraction and rejection well.

4 Abstraction only open loop, comprising of an abstraction well with water rejected to either the local sewer systems or river/water course.

Reasons for Excluding this Technology for this Site

In order to provide the anticipated heating and cooling bore holes would be required with sufficient distance needed between them. With the site having limited external areas, ground source heat pumps are deemed not suitable for this project and have not been considered further.

Existing services within the ground would prohibit the installation of a borehole type heat pump. Space limitations prohibit the installation of a 'slinky' type heat pump.

Wind Turbines

This section covers both large scale and micro wind solutions.

Large scale wind generation systems have capacities over 100kW and are usually used to power larger developments such as, larger scale housing, industrial estates and hotels with many rooms. These systems cannot be roof mounted due to their size and weight.

Reasons for Excluding this Technology for this Site

Due to the large capital cost and surroundings, large scale wind turbine systems are not considered viable at this project.

It is difficult to obtain predictable or large amounts of wind energy in city centre locations, as they require non-turbulent, horizontal air streams to be most effective. Surrounding buildings, trees, etc can cause significant issues with regards to micro and large scale installations unless the rotors are positioned at a considerable height.

Micro wind turbine technology has been found to be extremely difficult to achieve a contribution economically. A significant number of units would be required to provide any reasonable energy savings which would have serious visual impact implications.

Tall buildings give their own specific problems in that the building act as a spoiler, pushing wind upwards and over the turbine, reducing effectiveness considerably.

Additional considerations with large and micro wind solutions are the potential issues from stroboscopic light, topple distance, noise, impact on wildlife and structural enhancements which all raise major concerns given the building central London location.

Given the building location in central London and its close proximity to nearby buildings, achieving an acceptable solution that will provide sufficient renewable contribution as well as overcome the installation impacts is unlikely and therefore has not been considered for this project.