ENERGY STATEMENT

53-55 Station Road,
Hayes,
UB3 4BE

October 2023

Report Reference: 113256

Revision: -

Author: Tom Holland

UK Building Compliance
Unit 5, Carr House,
8 Hawley Road,
Hinckley,
Leicestershire,
LE10 0PR

www.ukbuildingcompliance.co.uk

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

1.1 UK Building Compliance have been appointed to undertake an Energy Statement on a proposed development in the London Borough of Hillingdon.

1.2 The scheme comprises of a proposed three-storey block of flats. The proposed site is to consist of residential use (Use Class C3).

1.3 This document has been produced to satisfy:

- Policy SI2 of the 2021 London Plan by providing at least a 35% improvement in regulated CO_2 over Part L of the Building Regulations 2013 through on-site measures & by following the energy hierarchy.

- Policy 5.6 of the 2020 GLA Energy Assessment Guidance by converting the above figures using the updated SAP 10 carbon emission factors.

1.4 This document details how the targets are met via:

- Low U-Values
- Low Air Permeability
- Air Source Heat Pump

1.5 This document has been written in adherence to the GLA Guide to Energy Statements.

2.0 POLICY FRAMEWORK

2.1 The following section outlines the relevant policy frameworks at national, regional and local level:

2.2 In March 2016, the Government confirmed its policy to limit local energy requirements and continue to support low carbon infrastructure. The Mayor has considered the Government's intentions regarding energy performance standards and its support for energy infrastructure and considers his energy targets within his energy hierarchy to be in line with this approach. It encourages developers to make carbon savings on-site, firstly through demand reduction. The remaining energy savings are met through low carbon infrastructure, either on-site or off-site.

2.3 Hillingdon Local Plan, reducing carbon dioxide emissions and adapting to future climate change are key considerations, this includes:

- The local plan: Part 1 – Strategic Policies
- The local plan: Part 2 – Development management policies

2.4 Other considerations include the Nation Policy Framework (2021) and National Planning Practice Guidance

REGIONAL POLICIES

2.3 The London Plan was updated in March 2021. A link to the new version can be found here: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

Policy SI2 Minimising greenhouse gas emissions;

A) Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) **be lean**: use less energy and manage demand during operation

2) **be clean**: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly

3) **be green**: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site

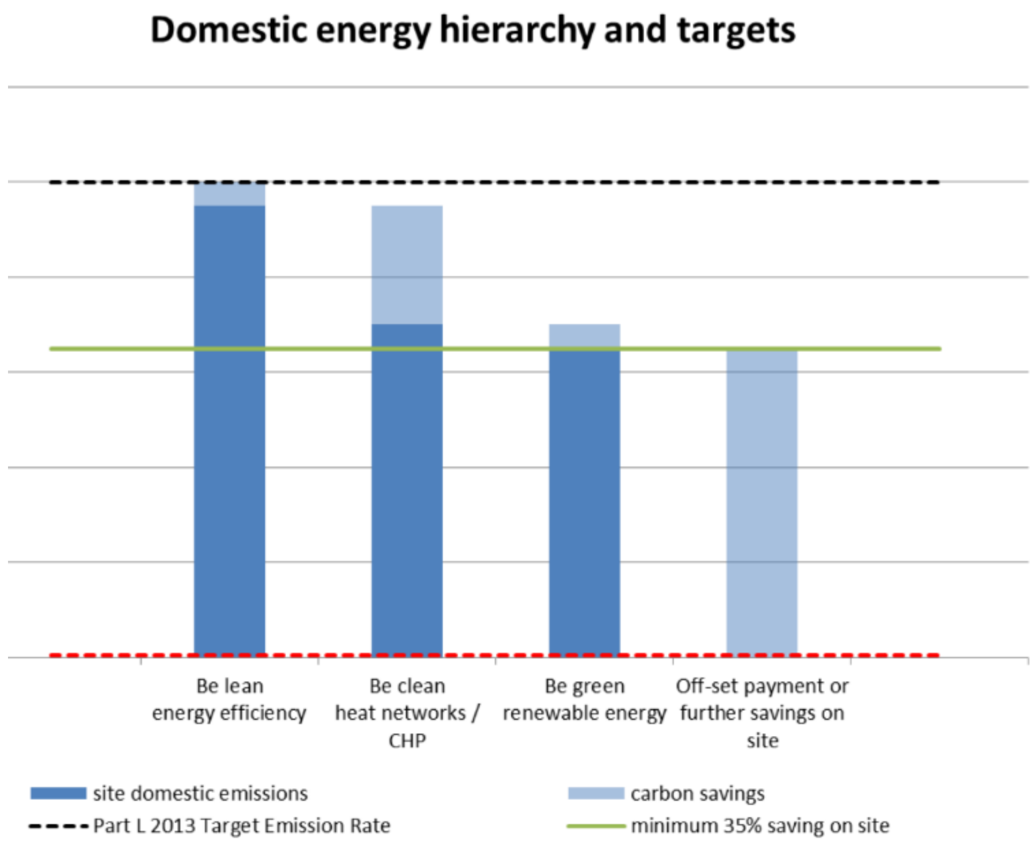
4) **be seen**: monitor, verify and report on energy performance

B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C) A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

2.6 To meet the zero-carbon target, an on-site reduction of at least 35 per cent beyond the baseline of Part L of the 2013 Building Regulations is required. The minimum improvement over the Target Emission Rate (TER) will increase over a period of time in order to achieve the zero-carbon London ambition and reflect the costs of more efficient construction methods. This will be reflected in future updates to the London Plan

2.7 A visual representation of the GLA Target in relation to Building Regulations where feasible is:



2.8 GLA guidance on preparing energy assessments has been altered to request that

"Planning applicants are encouraged to use updated (SAP 10) carbon emission factors to assess the expected carbon performance of a new development. Applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements (as outlined in Section 6) but with the outputs manually converted for the SAP 10 emission factors. A spreadsheet (version 1.1) has been developed for this purpose which should be submitted alongside an energy assessment. It should be noted that the use of the SAP 10 emission factors in this context is for demonstrating performance against planning policy targets and, as such, is separate to Building Regulation compliance. Applications should therefore ensure that compliance with Building Regulations is maintained."

Source: GLA. 2020. Energy Planning - GLA Guidance on preparing energy assessments. [ONLINE] Available at: https://www.london.gov.uk/sites/default/files/gla_energy_assessment_guidance_april_2020.pdf [Accessed October 2023].

3.0 BASELINE

3.1 SAP Calculations have been carried out on a representative sample using the Stroma FSAP Software Version 1.0.5.50 to gain the regulated emissions for the site.

Regulated Emissions are the CO_2 emissions covered under Part L of the Building Regulations and comprise of:

- **a)** Space Heating and Cooling
- **b)** Hot Water
- **c)** Lighting
- **d)** Pumps and Fans

A licensed and OCDEA accredited SAP Assessor has carried out the calculations.

Development emissions at this stage of the hierarchy are as follows:

	Regulated C02 Emissions – Tonnes per Annum SAP 2012	SAP 10 Conversion Factor Adjusted Figures	% improvement on TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	18.74	16.7	
After energy demand reduction *'Be Lean'*			
After CHP *'Be Clean'*			
After renewable energy *'Be Green'*			

4.0 BE LEAN

4.1 High energy efficiency standards are demonstrated in the table below. Construction Details have been selected to ensure that all fabric U-Values exceed the requirements of Part L of the Building Regulations (2013) and all Heating, Hot Water and Ventilation elements are in compliance with the Domestic Building Services Compliance Guide (2013). The proposed construction details for the residential units are as follows:

Elements	U Value	Development Notes
Ground Floor	0.12 w/m2/k	
Main External Walls	0.24 w/m2/k	
Sheltered Walls	0.11 w/m2/k	
Flat Roof	0.12 w/m2/k	
Windows	1.40 w/m2/k	Argon filled 16mm
External Doors	1.60 w/m2/k	Solid
Air Permeability	$5m^3/hm^2$@50Pa	
Ventilation	Natural Ventilation	
Heating	Gas Combi Boilers	
Heating Controls	Time & Temperature Zone Control	
Emitters	Radiators	
Secondary Heating	No	
Thermal Bridging	Constructive Details	
Lighting	100% LED	

A full sample SAP Input Data Sheet and SAP L1A Checklist can be found in Appendix 1 to verify the above inputs.

Following SAP Calculations, CO_2 emissions at this stage of the hierarchy are as follows:

	Regulated C02 Emissions – Tonnes per Annum SAP 2012	SAP 10 Conversion Factor : Adjusted Figures	% improvement on SAP 10 adjusted TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	18.74	16.7	
After energy demand reduction *'Be Lean'*	17.51	15.7	10.33%
After CHP *'Be Clean'*			
After renewable energy *'Be Green'*			

5.0 BE CLEAN

5.1 Policy SI3 of the London Plan advises the following:

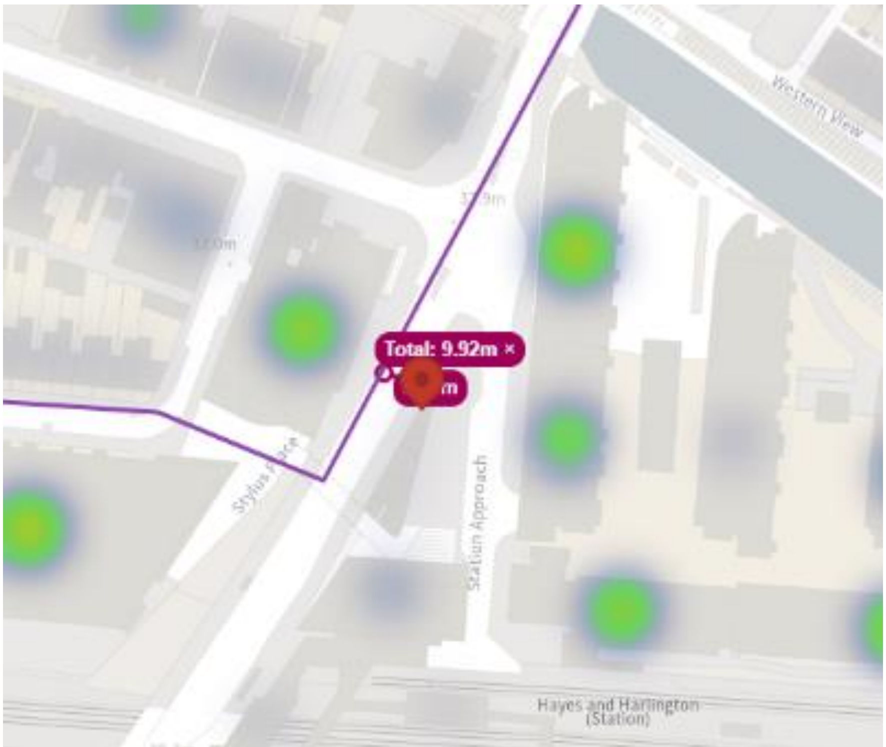
Major development proposals should select energy systems in accordance with the following hierarchy:

1. *Connection to existing heating or cooling networks;*
2. *Site wide CHP network;*
3. *Communal heating and cooling.*

(Source: Mayor of London. 2021. *The London Plan March 2021*. [ONLINE] Available at: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf)
[Accessed November 2021].

<u>HEAT MAP</u>

The site lies outside of any existing decentralised energy networks. There is a proposed heat network 9.92m away from the site.



CONNNECTION TO AREA WIDE LOW CARBON HEAT DISTRIBUTION NETWORKS

<u>EXISTING NETWORKS</u>

5.2 There are no existing heat networks within the site of the development. The possibility of utilising an existing area wide connection is therefore unfeasible.

PLANNED NETWORKS

5.3 There is a proposed heat network within 2km of the development which is a potential option for future development.

6.0 BE GREEN

6.1 The potential renewable energy applicable to this development and its feasibility is investigated below:

Renewable	Advantages	Disadvantages	Feasibility
Photovoltaic Panels	Can have significant impact on carbon by offsetting electricity which has a high carbon footprint. Low maintenance. No noise issues associated with PV. No additional land use from the installation of PV panels.	High capital investment required. Needs unobstructed space on roof. Solar PV has a reduced carbon reduction effect when incorporating the new SAP 10 emission factors than it did previously.	The development incorporates a pitched roof which is potentially suited to PV.
Solar Thermal Collectors	No additional land use from the installation of solar thermal collectors. Low maintenance and easy to manage. Low capital cost. No noise issues associated with Solar thermal collectors.	Limited CO_2 offset No Grants or Tariffs for new build installations.	Solar thermal collectors are feasible for the development, although it is not possible to meet the required carbon saving as the maximum demand that solar thermal collectors can be designed to meet can be no greater than 50% of the hot water demand.
Biomass Heating	Potential to reduce large component of the total CO_2. A biomass boiler would replace a standard gas heating system so some of the cost may be offset through money saved on a traditional boiler.	Regular maintenance will be required. Reliability of fuel may become a problem, therefore limited cost saving for residents. A plant room and fuel store will be required which may take additional land from the proposed development or surroundings. The fuel will need to be delivered, which can cause issues with access etc.	This is a small tight site in a dense urban area. Biomass is not considered feasible for such a development due to the need for space to accommodate fuel storages, access for delivery vehicles and local NOX emissions.

Ground Source Heat Pumps	Low maintenance and easy to manage Optimum efficiency with under- floor heating systems. As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump has a noise level around 45- 60dB so some attenuation may be required and it should be sensibly located. Relatively high capital cost. Requires electricity to run the pump, therefore limited carbon savings in most cases. For communal systems plant room required which may take additional land from the proposed development/ surroundings. High payback.	Limited Space on site and large communal infrastructure needed would remove and reduce amenity space.
Air Source Heat Pumps	ASHP systems are cheaper than ground source as there is no requirement for long lengths of buried piping. Low maintenance and easy to manage. Optimum efficiency with under- floor heating systems. As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump has a noise level around 50- 60dB so some attenuation may be required, and it should be sensibly located. The potential noise from the external unit may mean there is local opposition to their installation. Requires electricity to run the pump, therefore limited carbon savings in most cases. For communal systems, plant room is required which may take additional land from the proposed development/surroundings Potential noise issues.	This option is deemed the most appropriate. There would be space for the outdoor wall units to be fitted. This option previously did not meet a 25% reduction alone, but under the new SAP 10 figures – it becomes more favorable. This is due to the significant carbon emission reduction associated with the updated national grid figures.

6.2 The 35% offset has not been achieved without the need for the above renewable technologies.

6.3 The required reduction is to be achieved with the provision of an Air Source Heat Pump. Reductions are shown in the table below.

Elements	U Value	Development Notes
Ground Floor	0.12 w/m2/k	
Main External Walls	0.24 w/m2/k	
Sheltered Walls	0.11 w/m2/k	
Flat Roof	0.12 w/m2/k	

Windows	1.40 w/m2/k	Argon filled 16mm
External Doors	1.60 w/m2/k	Solid
Air Permeability	$5m^3/hm^2$@50Pa	
Ventilation	Natural Ventilation	
Heating	Air Source Heat Pumps	Vaillant Arotherm
Heating Controls	Time & Temperature Zone Control	
Emitters	Radiators	
Secondary Heating	No	
Thermal Bridging	Constructive Details	
Lighting	100% LED	

6.4 Development emissions at this stage of the hierarchy are as follows:

	Regulated C02 Emissions – Tonnes per Annum SAP 2012	SAP 10 Conversion Factor : Adjusted Figures	% improvement on SAP 10 adjusted TER
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	18.74	16.7	
After energy demand reduction *'Be Lean'*	17.51	15.7	10.33%
After CHP *'Be Clean'*			
After renewable energy *'Be Green'*	23.94	10.7	35.92%

Appendix 2 shows the full breakdown of:

- floor area of each dwelling and respective emission rate.
- the Dwelling Emission Rate (DER) in terms of $kg/m^2/year$.
- the CO2 saved through the proposed use of energy efficient measures.

7.0 COOLING AND OVERHEATING

THE COOLING HIERARCHY

7.1 Pursuant with Policy 5.9 of the London Plan the following measures have been investigated:

Cooling Hierarchy	Measures Undertaken
1. Minimising internal heat generation through energy efficient design	Individual heating means the associated heat loss associated with communal heat pipes will not apply to this project.
2. Reducing the amount of heat entering the building in summer	Carefully designed shading measures have been considered, including: Specification of blinds.
3. Use of thermal mass and high ceilings to manage the heat within the building	Level of exposed thermal mass has been maximised to help to absorb excess heat within the building.
4. Passive Ventilation	The use of: Openable windows, Dual aspect units, Designing in the 'stack effect.
5. Mechanical Ventilation	N/A

OVERHEATING RISK ANALYSIS

7.2 Criterion 3 of Part L 2013 of the Building Regulations relates to limiting the effects of heat gains in summer - this is implemented for new dwellings as set out in Appendix P of SAP 2012.

The project passes this criterion.

However, the Building Regulations recognises that Criterion 3 does not cover all factors influencing overheating and that there is no guarantee that buildings will not overheat.

7.3 CIBSE Guide A – Environmental Design (2015) is the reference standard for overheating in the GLA SPG on Sustainability and the current industry standard amongst other CIBSE guides such as CIBSE TM52 "The Limits of Thermal Comfort: Avoiding Overheating in European Buildings" (2013). These set out guidelines on the number of hours a dwelling should not exceed a certain temperature.

7.4 The risk of summertime overheating has been assessed as 'slight'.

8.0 WATER CONSUMPTION

8.1 The following section outlines the schemes' requirements and proposal for sustainable water consumption.

8.2 NATIONAL POLICIES

Part G of the 2013 England & Wales Building Regulations outlines the following requirement:

"The estimated consumption of wholesome water of a new dwelling should be no more than 125 liters/person/day or 110 liters/person/day where the optional requirement applies. This includes a fixed factor of water for outdoor use of 5 liters/ person/day."

8.3 WATER PROPOSAL

8.4 It is proposed that the 110 liters per person per day target will be achieved through the installment of water efficient appliances.

8.5 Table 1 specifies the requirements for the properties water-based appliances and calculates how this demand reduction will lead to water consumption of below 110 litres per person per day.

8.6 The various flow rates and capacities of the appliances listed in Table 1 should be adhered to when purchasing items for the properties.

8.7 WATER CALCULATIONS

Installation Type	Unit of Measure	Quantity	Capacity/ Flow Rate	Use factor	Fixed Use	Total L/P/D
WC (single flush)	Flush (L)	0	0.00	4.42	0.00	0.00
WC (dual flush)	Full flush (L)	6	4.80	1.46	0.00	7.01
	Part flush (L)		2.40	2.96	0.00	7.10
Taps (excl kitchen/utility)	Flow (L/minute)	1	4.00	1.58	1.58	7.90
Baths	Capacity (L)	1	180.00	0.11	0.00	19.80
Showers	Flow (L/minute)	1	9.00	4.37	0.00	39.33
Kitchen/Utility Room Taps	Flow (L/minute)	1	5.00	0.44	10.36	12.56
Washing Machine	L/kg dry load	1	8.00	2.10	0.00	16.80
Dishwasher	L/place setting	1	1.25	3.60	0.00	4.50
Waste Disposal Unit	L/use	0	0.00	3.08	0.00	0.00
Water Softener	L/P/D	0	0.00	1.00	0.00	0.00
		Total calculated use (litres/person/day)				115.00
		Contribution from Greywater (litres/person/day)				0.00
		Contribution from Rainwater (litres/person/day)				0.00
		Normalisation factor				0.91
		Total water consumption				104.65
		External water use				5.00
		Total Water Consumption (Building Regulation 17.K)				**109.65**

8.8 The water consumption for the site in question is calculated to be 109.65 litres per person per day.

9.0 SUSTAINABLE CONSTRUCTION

9.1 The Developer will monitor and record waste produce from site activities to ensure that the maximum possible will be diverted from landfill and reused in line with the waste hierarchy (below). This may be via a SWMP or via a licensed waste contractor.

9.2 All timber will be purchased in line with the Government's Policy for UK Timber Procurement.

9.3 Should the developer and client wish to go further than the mandatory requirements, the following voluntary BREEAM options could be considered when sourcing materials;

- Responsible sourcing certifications e.g. EMS (EMAS, ISO14001).
- Chain of custody and/or BES6001 for key and supply chain processes.
- Legally sourced timber: Chain of custody and certificate (FSC, SFI, PEFC, MTCC, SGS, TFT, Verified etc).

10.0 CONCLUSION

10.1 This document is written in accordance with the guidelines and requirements of:

- Policy SI2 of the 2021 London Plan
- Policy 5.6 of the 2020 GLA Energy Assessment Guidance

10.2 The development has CO_2 baseline emissions that are Part L compliant via passive energy efficiency measures alone.

10.3 In addition to the passive measures and high energy efficiency standards, an efficient Air Source Heat Pump will be incorporated in order to achieve the required reduction in CO_2 emissions.

Appendix 1

Sample SAP Reports – Be Lean

SAP Input

Property Details: GF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	Storey height:
Floor 0	60.29 m²	2.5 m
Living area:	25.32 m² (fraction 0.42)	
Front of dwelling faces:	South East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
se	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
se	16mm or more	0.7	0.63	1.3	3.33	1
nw	16mm or more	0.7	0.63	1.3	6.15	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
se		Ext.	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	52.77	9.48	43.29	0.24	0	False	N/A
Shel	22.8	0	22.8	0.24	0.43	False	N/A
Flat	8.04	0	8.04	0.12	0		N/A
GF	60.29			0.12			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0498

Length	Psi-value		
5.14	0.05	E2	Other lintels (including other steel lintels)
1.42	0.034	E3	Sill

SAP Input

15.06	0.04	E4	Jamb
30.23	0.079	E5	Ground floor (normal)
8.88	0.08	E14	Flat roof
2.5	0.058	E16	Corner (normal)
5	-0.069	E17	Corner (inverted internal area greater than external area)
12.5	0.068	E18	Party wall between dwellings
12.99	0.16	P1	Ground floor
1.81	0.24	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Manufacturer Declaration Manufacturer's data Efficiency: 96.0% (SEDBUK2009) Condensing combi with automatic ignition Fuel Burning Type: Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Unknown Boiler interlock: Yes Delayed start

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 512, product index) Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No

SAP Input

Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: GF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.29	(1a) x	2.5	(2a) =	150.73	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.29	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		150.73	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.33	(21)

Infiltration rate modified for monthly wind speed

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

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	0.33	0.35	0.37	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.33	x1/[1/(1.3)+ 0.04]		=	4.12			(27)
Windows Type 2			6.15	x1/[1/(1.3)+ 0.04]		=	7.6			(27)
Floor			60.29	x	0.12	=	7.2348			(28)
Walls Type1	52.77	9.48	43.29	x	0.24	=	10.39			(29)
Walls Type2	22.8	0	22.8	x	0.22	=	4.96			(29)
Roof	8.04	0	8.04	x	0.12	=	0.96			(30)
Total area of elements, m²			143.9							(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) = 35.26 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 72.36 (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 7.17 (36)

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

Total fabric heat loss (33) + (36) = 42.43 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.15	28.98	28.82	28.05	27.91	27.24	27.24	27.12	27.5	27.91	28.2	28.5	(38)

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

(39)m=	71.58	71.41	71.25	70.49	70.34	69.68	69.68	69.55	69.93	70.34	70.63	70.94	

Average = Sum(39)$_{1…12}$ /12= 70.49 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.19	1.18	1.18	1.17	1.17	1.16	1.16	1.15	1.16	1.17	1.17	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 1.99 (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 81.46 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.6	86.35	83.09	79.83	76.57	73.31	73.31	76.57	79.83	83.09	86.35	89.6	
										Total = Sum(44)$_{1…12}$ =		977.5	(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=	132.88	116.22	119.93	104.55	100.32	86.57	80.22	92.05	93.15	108.56	118.5	128.69	
										Total = Sum(45)$_{1…12}$ =		1281.66	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.93	17.43	17.99	15.68	15.05	12.99	12.03	13.81	13.97	16.28	17.78	19.3	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	45.66	39.74	42.34	39.37	39.02	36.15	37.36	39.02	39.37	42.34	42.58	45.66	(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=	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	

Output from water heater (annual)$_{1...12}$ 1770.27 (64)

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

(65)m=	55.6	48.58	50.46	44.61	43.11	37.82	36.01	40.36	40.82	46.68	50.05	54.2	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	(66)

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

(67)m=	40.52	35.99	29.27	22.16	16.57	13.99	15.11	19.64	26.36	33.48	39.07	41.65	(67)

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

(68)m=	259.22	261.91	255.13	240.7	222.49	205.37	193.93	191.24	198.02	212.45	230.66	247.78	(68)

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

(69)m=	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	(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=	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	(71)

Water heating gains (Table 5)

(72)m=	74.73	72.29	67.82	61.95	57.95	52.53	48.4	54.25	56.69	62.74	69.51	72.85	(72)

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

(73)m=	466.2	461.92	443.95	416.54	388.72	363.61	349.17	356.86	372.79	400.39	430.97	454.01	(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)	
Southeast 0.9x	0.77	x	3.33	x	36.79	x	0.63	x	0.7	=	37.44	(77)
Southeast 0.9x	0.77	x	3.33	x	62.67	x	0.63	x	0.7	=	63.78	(77)
Southeast 0.9x	0.77	x	3.33	x	85.75	x	0.63	x	0.7	=	87.27	(77)
Southeast 0.9x	0.77	x	3.33	x	106.25	x	0.63	x	0.7	=	108.13	(77)

Southeast	0.9x	0.77	x	3.33	x	119.01	x	0.63	x	0.7	=	121.12	(77)
Southeast	0.9x	0.77	x	3.33	x	118.15	x	0.63	x	0.7	=	120.24	(77)
Southeast	0.9x	0.77	x	3.33	x	113.91	x	0.63	x	0.7	=	115.92	(77)
Southeast	0.9x	0.77	x	3.33	x	104.39	x	0.63	x	0.7	=	106.24	(77)
Southeast	0.9x	0.77	x	3.33	x	92.85	x	0.63	x	0.7	=	94.49	(77)
Southeast	0.9x	0.77	x	3.33	x	69.27	x	0.63	x	0.7	=	70.49	(77)
Southeast	0.9x	0.77	x	3.33	x	44.07	x	0.63	x	0.7	=	44.85	(77)
Southeast	0.9x	0.77	x	3.33	x	31.49	x	0.63	x	0.7	=	32.04	(77)
Northwest	0.9x	0.77	x	6.15	x	11.28	x	0.63	x	0.7	=	21.21	(81)
Northwest	0.9x	0.77	x	6.15	x	22.97	x	0.63	x	0.7	=	43.17	(81)
Northwest	0.9x	0.77	x	6.15	x	41.38	x	0.63	x	0.7	=	77.77	(81)
Northwest	0.9x	0.77	x	6.15	x	67.96	x	0.63	x	0.7	=	127.72	(81)
Northwest	0.9x	0.77	x	6.15	x	91.35	x	0.63	x	0.7	=	171.69	(81)
Northwest	0.9x	0.77	x	6.15	x	97.38	x	0.63	x	0.7	=	183.04	(81)
Northwest	0.9x	0.77	x	6.15	x	91.1	x	0.63	x	0.7	=	171.23	(81)
Northwest	0.9x	0.77	x	6.15	x	72.63	x	0.63	x	0.7	=	136.5	(81)
Northwest	0.9x	0.77	x	6.15	x	50.42	x	0.63	x	0.7	=	94.77	(81)
Northwest	0.9x	0.77	x	6.15	x	28.07	x	0.63	x	0.7	=	52.75	(81)
Northwest	0.9x	0.77	x	6.15	x	14.2	x	0.63	x	0.7	=	26.68	(81)
Northwest	0.9x	0.77	x	6.15	x	9.21	x	0.63	x	0.7	=	17.32	(81)

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

(83)m=	58.65	106.95	165.04	235.86	292.8	303.28	287.15	242.74	189.26	123.25	71.53	49.36	(83)

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

(84)m=	524.85	568.87	608.99	652.4	681.53	666.88	636.32	599.6	562.05	523.64	502.5	503.38	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.92	0.81	0.64	0.48	0.52	0.76	0.94	0.98	0.99	(86)

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

(87)m=	19.95	20.09	20.31	20.61	20.85	20.97	20.99	20.99	20.92	20.63	20.24	19.93	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.9	0.76	0.55	0.37	0.41	0.68	0.91	0.98	0.99	(89)

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

(90)m=	18.57	18.76	19.09	19.5	19.8	19.93	19.95	19.95	19.89	19.54	19	18.53	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	19.15	19.32	19.6	19.97	20.24	20.37	20.39	20.39	20.32	19.99	19.52	19.12	(92)

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

(93)m=	19	19.17	19.45	19.82	20.09	20.22	20.24	20.24	20.17	19.84	19.37	18.97	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.89	0.77	0.57	0.4	0.44	0.7	0.91	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	515.99	554.01	579.66	582.51	523.11	379.73	252.11	264.41	393.15	475.71	487.72	496.26	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1052.27	1018.91	922.81	769.62	590.31	391.44	253.64	266.99	424.64	650.29	866.59	1047.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	398.99	312.41	255.31	134.72	50	0	0	0	0	129.88	272.79	410.24	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1964.33 (98)

Space heating requirement in kWh/m²/year 32.58 (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		96.8	(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)													
	398.99	312.41	255.31	134.72	50	0	0	0	0	129.88	272.79	410.24	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	412.18	322.73	263.75	139.17	51.65	0	0	0	0	134.18	281.81	423.8	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2029.27 (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)

	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	
Efficiency of water heater												87.5	(216)
(217)m=	93.72	93.49	92.96	91.76	89.78	87.5	87.5	87.5	87.5	91.57	93.13	93.83	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	190.5	166.82	174.55	156.84	155.21	140.26	134.38	149.8	151.45	164.8	172.98	185.82	

Total = Sum(219a)$_{1...12}$ = 1943.41 (219)

Annual totals	kWh/year	kWh/year
Space heating fuel used, main system 1		2029.27

SAP WorkSheet: New dwelling design stage

Water heating fuel used			1943.41	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			286.27	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4288.95	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	70.62	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	67.63	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	37.76	(250)
Additional standing charges (Table 12)				120	(251)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			299.97	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.2	(257)
SAP rating (Section 12)		83.31	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	438.32	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	419.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			858.1	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	148.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		1022.24	(272)
CO2 emissions per m²		(272) ÷ (4) =		16.96	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

SAP WorkSheet: New dwelling design stage

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2475.71	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2370.96	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4846.67	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	92.1	(267)
Electricity for lighting	(232)	x	0	=	878.84	(268)
'Total Primary Energy			sum of (265)…(271) =		5817.61	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		96.49	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: GF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.29	(1a)	x	2.5	(2a)	=	150.73	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			150.73	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

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

DER 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	0.33	0.35	0.37	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.33	x1/[1/(1.3)+ 0.04]		=	4.12			(27)
Windows Type 2			6.15	x1/[1/(1.3)+ 0.04]		=	7.6			(27)
Floor			60.29	x	0.12	=	7.2348			(28)
Walls Type1	52.77	9.48	43.29	x	0.24	=	10.39			(29)
Walls Type2	22.8	0	22.8	x	0.22	=	4.96			(29)
Roof	8.04	0	8.04	x	0.12	=	0.96			(30)
Total area of elements, m²			143.9							(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) = 35.26 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 72.36 (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 7.17 (36)

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

Total fabric heat loss (33) + (36) = 42.43 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.15	28.98	28.82	28.05	27.91	27.24	27.24	27.12	27.5	27.91	28.2	28.5	(38)

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

(39)m=	71.58	71.41	71.25	70.49	70.34	69.68	69.68	69.55	69.93	70.34	70.63	70.94	

Average = Sum(39)$_{1…12}$ /12= 70.49 (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=	1.19	1.18	1.18	1.17	1.17	1.16	1.16	1.15	1.16	1.17	1.17	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 1.99 (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 81.46 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	89.6	86.35	83.09	79.83	76.57	73.31	73.31	76.57	79.83	83.09	86.35	89.6	

Total = Sum(44)$_{1…12}$ = 977.5 (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=	132.88	116.22	119.93	104.55	100.32	86.57	80.22	92.05	93.15	108.56	118.5	128.69	

Total = Sum(45)$_{1…12}$ = 1281.66 (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.93	17.43	17.99	15.68	15.05	12.99	12.03	13.81	13.97	16.28	17.78	19.3	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

DER WorkSheet: New dwelling design stage

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

(61)m=	45.66	39.74	42.34	39.37	39.02	36.15	37.36	39.02	39.37	42.34	42.58	45.66	(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=	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	

Output from water heater (annual)$_{1...12}$ 1770.27 (64)

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

(65)m=	55.6	48.58	50.46	44.61	43.11	37.82	36.01	40.36	40.82	46.68	50.05	54.2	(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=	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	(66)

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

(67)m=	16.21	14.4	11.71	8.86	6.63	5.59	6.04	7.86	10.55	13.39	15.63	16.66	(67)

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

(68)m=	173.68	175.48	170.94	161.27	149.07	137.59	129.93	128.13	132.67	142.34	154.54	166.01	(68)

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

(69)m=	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	(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=	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	(71)

Water heating gains (Table 5)

(72)m=	74.73	72.29	67.82	61.95	57.95	52.53	48.4	54.25	56.69	62.74	69.51	72.85	(72)

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

(73)m=	320.46	318.01	306.32	287.93	269.49	251.57	240.23	246.08	255.75	274.32	295.53	311.38	(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)	
Southeast	0.9x	0.77	x	3.33	x	36.79	x	0.63	x	0.7	=	37.44	(77)
Southeast	0.9x	0.77	x	3.33	x	62.67	x	0.63	x	0.7	=	63.78	(77)
Southeast	0.9x	0.77	x	3.33	x	85.75	x	0.63	x	0.7	=	87.27	(77)
Southeast	0.9x	0.77	x	3.33	x	106.25	x	0.63	x	0.7	=	108.13	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	3.33	x	119.01	x	0.63	x	0.7	=	121.12	(77)
Southeast	0.9x	0.77	x	3.33	x	118.15	x	0.63	x	0.7	=	120.24	(77)
Southeast	0.9x	0.77	x	3.33	x	113.91	x	0.63	x	0.7	=	115.92	(77)
Southeast	0.9x	0.77	x	3.33	x	104.39	x	0.63	x	0.7	=	106.24	(77)
Southeast	0.9x	0.77	x	3.33	x	92.85	x	0.63	x	0.7	=	94.49	(77)
Southeast	0.9x	0.77	x	3.33	x	69.27	x	0.63	x	0.7	=	70.49	(77)
Southeast	0.9x	0.77	x	3.33	x	44.07	x	0.63	x	0.7	=	44.85	(77)
Southeast	0.9x	0.77	x	3.33	x	31.49	x	0.63	x	0.7	=	32.04	(77)
Northwest	0.9x	0.77	x	6.15	x	11.28	x	0.63	x	0.7	=	21.21	(81)
Northwest	0.9x	0.77	x	6.15	x	22.97	x	0.63	x	0.7	=	43.17	(81)
Northwest	0.9x	0.77	x	6.15	x	41.38	x	0.63	x	0.7	=	77.77	(81)
Northwest	0.9x	0.77	x	6.15	x	67.96	x	0.63	x	0.7	=	127.72	(81)
Northwest	0.9x	0.77	x	6.15	x	91.35	x	0.63	x	0.7	=	171.69	(81)
Northwest	0.9x	0.77	x	6.15	x	97.38	x	0.63	x	0.7	=	183.04	(81)
Northwest	0.9x	0.77	x	6.15	x	91.1	x	0.63	x	0.7	=	171.23	(81)
Northwest	0.9x	0.77	x	6.15	x	72.63	x	0.63	x	0.7	=	136.5	(81)
Northwest	0.9x	0.77	x	6.15	x	50.42	x	0.63	x	0.7	=	94.77	(81)
Northwest	0.9x	0.77	x	6.15	x	28.07	x	0.63	x	0.7	=	52.75	(81)
Northwest	0.9x	0.77	x	6.15	x	14.2	x	0.63	x	0.7	=	26.68	(81)
Northwest	0.9x	0.77	x	6.15	x	9.21	x	0.63	x	0.7	=	17.32	(81)

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

(83)m=	58.65	106.95	165.04	235.86	292.8	303.28	287.15	242.74	189.26	123.25	71.53	49.36	(83)

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

(84)m=	379.11	424.96	471.36	523.79	562.29	554.84	527.38	488.83	445.01	397.57	367.06	360.74	(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	0.96	0.89	0.73	0.56	0.63	0.86	0.98	1	1	(86)

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

(87)m=	19.74	19.87	20.12	20.46	20.76	20.94	20.99	20.98	20.85	20.47	20.04	19.71	(87)

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

(88)m=	19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	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	0.95	0.85	0.64	0.44	0.5	0.8	0.97	0.99	1	(89)

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

(90)m=	18.25	18.46	18.82	19.31	19.71	19.91	19.95	19.95	19.83	19.32	18.71	18.22	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	18.87	19.05	19.36	19.79	20.15	20.34	20.39	20.38	20.26	19.8	19.27	18.85	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	18.72	18.9	19.21	19.64	20	20.19	20.24	20.23	20.11	19.65	19.12	18.7	(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	0.99	0.98	0.94	0.85	0.66	0.47	0.53	0.81	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	377.34	421.27	462.06	494.57	476.65	367.26	249.92	260.48	359.63	382.28	363.76	359.41	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1032.52	999.93	905.89	757.04	583.85	389.75	253.31	266.42	420.02	636.93	849	1028.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	487.45	388.85	330.21	188.98	79.75	0	0	0	0	189.46	349.37	497.68	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2511.76 (98)

Space heating requirement in kWh/m²/year 41.66 (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		96.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	487.45	388.85	330.21	188.98	79.75	0	0	0	0	189.46	349.37	497.68	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	503.57	401.71	341.12	195.23	82.39	0	0	0	0	195.72	360.92	514.13	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2594.79 (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)													
	178.54	155.96	162.27	143.92	139.34	122.73	117.58	131.07	132.52	150.9	161.09	174.35	
Efficiency of water heater												87.5	(216)
(217)m=	94.12	93.94	93.52	92.55	90.67	87.5	87.5	87.5	87.5	92.44	93.66	94.2	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	189.7	166.02	173.5	155.51	153.68	140.26	134.38	149.8	151.45	163.24	171.99	185.08	

Total = Sum(219a)$_{1...12}$ = 1934.61 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2594.79

Water heating fuel used			1934.61	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			286.27	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4845.66	(338)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	560.47	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	417.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			978.35	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	148.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		1142.49	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.95	(273)
EI rating (section 14)				85	(274)

SAP Input

Property Details: FF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	Storey height:
Floor 0	73.21 m²	2.5 m
Living area:	29.99 m² (fraction 0.41)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
ne	Manufacturer	Solid			Wood
se	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
ne	mm	0.7	0.63	1.6	1.89	1
se	16mm or more	0.7	0.63	1.3	13.33	1
nw	16mm or more	0.7	0.63	1.3	5.64	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
ne		Shel	North East	0	0
se		Ext.	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	71.92	18.97	52.95	0.24	0	False	N/A
Shel	13.03	1.89	11.14	0.11	0.43	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0543

Length	**Psi-value**		
10.42	0.05	E2	Other lintels (including other steel lintels)

SAP Input

	2.04	0.034	E3	Sill
	24.04	0.04	E4	Jamb
	10	0.058	E16	Corner (normal)
	2.5	-0.069	E17	Corner (inverted internal area greater than external area)
	2.5	0.068	E18	Party wall between dwellings
	33.98	0.073	E7	Party floor between dwellings (in blocks of flats)
	3.39	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Manufacturer Declaration Manufacturer's data Efficiency: 96.0% (SEDBUK2009) Condensing combi with automatic ignition Fuel Burning Type: Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Unknown Boiler interlock: Yes Delayed start

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 512, product index) Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None

SAP Input

Assess Zero Carbon Home: No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: FF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.21	(1a) x	2.5	(2a) =	183.02	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.21	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	183.02	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

SAP WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			13.33	x1/[1/(1.3)+ 0.04]		=	16.47			(27)
Windows Type 2			5.64	x1/[1/(1.3)+ 0.04]		=	6.97			(27)
Walls Type1	71.92	18.97	52.95	x	0.24	=	12.71			(29)
Walls Type2	13.03	1.89	11.14	x	0.11	=	1.17			(29)
Total area of elements, m²			84.95							(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) = 40.34 (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 4.61 (36)

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

Total fabric heat loss (33) + (36) = 44.95 (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=	36.28	36.04	35.81	34.72	34.52	33.57	33.57	33.4	33.94	34.52	34.93	35.36	(38)

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

(39)m=	81.23	80.99	80.76	79.68	79.47	78.53	78.53	78.35	78.89	79.47	79.88	80.31	

Average = Sum(39)$_{1…12}$ /12= 79.68 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.32 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.33 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.27	94.69	91.12	87.55	83.97	80.4	80.4	83.97	87.55	91.12	94.69	98.27	
												Total = Sum(44)$_{1…12}$ = 1072.02	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	145.73	127.46	131.52	114.66	110.02	94.94	87.98	100.96	102.16	119.06	129.96	141.13	
												Total = Sum(45)$_{1…12}$ = 1405.59	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.86	19.12	19.73	17.2	16.5	14.24	13.2	15.14	15.32	17.86	19.49	21.17	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.08	43.59	46.43	43.17	42.79	39.65	40.97	42.79	43.17	46.43	46.7	50.08	(61)

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

(62)m=	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21	

Output from water heater (annual)$_{1...12}$ 1941.45 (64)

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

(65)m=	60.97	53.28	55.34	48.92	47.28	41.48	39.5	44.27	44.76	51.2	54.89	59.45	(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=	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	(66)

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

(67)m=	45.62	40.52	32.95	24.95	18.65	15.74	17.01	22.11	29.68	37.68	43.98	46.88	(67)

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

(68)m=	305.48	308.65	300.66	283.65	262.19	242.01	228.53	225.36	233.35	250.36	271.82	292	(68)

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

(69)m=	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	(71)

Water heating gains (Table 5)

(72)m=	81.95	79.28	74.38	67.94	63.55	57.61	53.09	59.5	62.17	68.81	76.23	79.9	(72)

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

(73)m=	533.73	529.12	508.67	477.22	445.06	416.05	399.31	407.65	425.88	457.53	492.72	519.46	(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)	
Southeast	0.9x	0.77	x	13.33	x	36.79	x	0.63	x	0.7	=	149.89	(77)
Southeast	0.9x	0.77	x	13.33	x	62.67	x	0.63	x	0.7	=	255.32	(77)
Southeast	0.9x	0.77	x	13.33	x	85.75	x	0.63	x	0.7	=	349.34	(77)
Southeast	0.9x	0.77	x	13.33	x	106.25	x	0.63	x	0.7	=	432.85	(77)

SAP WorkSheet: New dwelling design stage

Southeast 0.9x	0.77	x	13.33	x	119.01	x	0.63	x	0.7	=	484.83	(77)
Southeast 0.9x	0.77	x	13.33	x	118.15	x	0.63	x	0.7	=	481.32	(77)
Southeast 0.9x	0.77	x	13.33	x	113.91	x	0.63	x	0.7	=	464.05	(77)
Southeast 0.9x	0.77	x	13.33	x	104.39	x	0.63	x	0.7	=	425.27	(77)
Southeast 0.9x	0.77	x	13.33	x	92.85	x	0.63	x	0.7	=	378.26	(77)
Southeast 0.9x	0.77	x	13.33	x	69.27	x	0.63	x	0.7	=	282.18	(77)
Southeast 0.9x	0.77	x	13.33	x	44.07	x	0.63	x	0.7	=	179.54	(77)
Southeast 0.9x	0.77	x	13.33	x	31.49	x	0.63	x	0.7	=	128.28	(77)
Northwest 0.9x	0.77	x	5.64	x	11.28	x	0.63	x	0.7	=	19.45	(81)
Northwest 0.9x	0.77	x	5.64	x	22.97	x	0.63	x	0.7	=	39.59	(81)
Northwest 0.9x	0.77	x	5.64	x	41.38	x	0.63	x	0.7	=	71.32	(81)
Northwest 0.9x	0.77	x	5.64	x	67.96	x	0.63	x	0.7	=	117.13	(81)
Northwest 0.9x	0.77	x	5.64	x	91.35	x	0.63	x	0.7	=	157.45	(81)
Northwest 0.9x	0.77	x	5.64	x	97.38	x	0.63	x	0.7	=	167.86	(81)
Northwest 0.9x	0.77	x	5.64	x	91.1	x	0.63	x	0.7	=	157.03	(81)
Northwest 0.9x	0.77	x	5.64	x	72.63	x	0.63	x	0.7	=	125.18	(81)
Northwest 0.9x	0.77	x	5.64	x	50.42	x	0.63	x	0.7	=	86.91	(81)
Northwest 0.9x	0.77	x	5.64	x	28.07	x	0.63	x	0.7	=	48.38	(81)
Northwest 0.9x	0.77	x	5.64	x	14.2	x	0.63	x	0.7	=	24.47	(81)
Northwest 0.9x	0.77	x	5.64	x	9.21	x	0.63	x	0.7	=	15.88	(81)

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

(83)m=	169.34	294.91	420.66	549.98	642.28	649.18	621.07	550.45	465.17	330.56	204.01	144.16	(83)

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

(84)m=	703.07	824.03	929.33	1027.21	1087.34	1065.23	1020.38	958.1	891.05	788.09	696.72	663.62	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.96	0.92	0.81	0.65	0.47	0.34	0.37	0.59	0.86	0.97	0.99	(86)

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

(87)m=	20.14	20.34	20.59	20.83	20.96	20.99	21	21	20.98	20.81	20.43	20.1	(87)

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

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

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

(89)m=	0.98	0.95	0.9	0.77	0.59	0.4	0.26	0.3	0.52	0.82	0.95	0.98	(89)

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

(90)m=	18.88	19.17	19.51	19.83	19.98	20.02	20.02	20.02	20.01	19.82	19.31	18.83	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

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

(92)m=	19.4	19.65	19.95	20.24	20.38	20.42	20.42	20.42	20.4	20.22	19.77	19.35	(92)

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

(93)m=	19.25	19.5	19.8	20.09	20.23	20.27	20.27	20.27	20.25	20.07	19.62	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=	0.97	0.95	0.89	0.78	0.6	0.42	0.28	0.32	0.53	0.82	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	684.91	781.01	829.77	796.5	655.32	442.62	288.16	303.04	476.43	646.61	661.26	650.04	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1214.23	1182.41	1074.45	891.82	677.66	445.13	288.41	303.5	485.5	752.73	1000.27	1204.93	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	393.81	269.74	182.05	68.63	16.62	0	0	0	0	78.95	244.09	412.84	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1666.73 (98)

Space heating requirement in kWh/m²/year 22.77 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		96.8	(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)														
	393.81	269.74	182.05	68.63	16.62	0	0	0	0	78.95	244.09	412.84		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	406.83	278.66	188.07	70.9	17.17	0	0	0	0	81.56	252.15	426.49		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1721.83	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21		
Efficiency of water heater													87.5	(216)
(217)m=	93.5	92.97	91.97	90.12	88.33	87.5	87.5	87.5	87.5	90.3	92.66	93.65		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	209.42	183.98	193.5	175.14	173	153.82	147.37	164.28	166.1	183.27	190.65	204.17		
Total = Sum(219a)$_{1...12}$ =													2144.7	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1721.83

SAP WorkSheet: New dwelling design stage

Water heating fuel used		2144.7	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		322.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		4218.76	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	59.92	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	74.64	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	42.5	(250)
Additional standing charges (Table 12)				120	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	301.02	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.07	(257)
SAP rating (Section 12)		85.08	(258)

12a. CO_2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	371.92	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	463.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =			835.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	167.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		1017.98	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.9	(273)
EI rating (section 14)				88	(274)

13a. Primary Energy

SAP WorkSheet: New dwelling design stage

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2100.63	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2616.53	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4717.16	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	92.1	(267)
Electricity for lighting	(232)	x	0	=	989.27	(268)
'Total Primary Energy			sum of (265)…(271) =		5798.53	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		79.2	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: FF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.21	(1a) x	2.5	(2a) =	183.02	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.21	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	183.02	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.16	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.41	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.35	(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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			13.33	x1/[1/(1.3)+ 0.04]		=	16.47			(27)
Windows Type 2			5.64	x1/[1/(1.3)+ 0.04]		=	6.97			(27)
Walls Type1	71.92	18.97	52.95	x	0.24	=	12.71			(29)
Walls Type2	13.03	1.89	11.14	x	0.11	=	1.17			(29)
Total area of elements, m²			84.95							(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) = 40.34 (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 4.61 (36)

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

Total fabric heat loss (33) + (36) = 44.95 (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=	36.28	36.04	35.81	34.72	34.52	33.57	33.57	33.4	33.94	34.52	34.93	35.36	(38)

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

(39)m=	81.23	80.99	80.76	79.68	79.47	78.53	78.53	78.35	78.89	79.47	79.88	80.31	

Average = Sum(39)$_{1…12}$ /12= 79.68 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.32 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.33 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.27	94.69	91.12	87.55	83.97	80.4	80.4	83.97	87.55	91.12	94.69	98.27	
										Total = Sum(44)$_{1…12}$ =		1072.02	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	145.73	127.46	131.52	114.66	110.02	94.94	87.98	100.96	102.16	119.06	129.96	141.13	
										Total = Sum(45)$_{1…12}$ =		1405.59	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.86	19.12	19.73	17.2	16.5	14.24	13.2	15.14	15.32	17.86	19.49	21.17	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.08	43.59	46.43	43.17	42.79	39.65	40.97	42.79	43.17	46.43	46.7	50.08	(61)

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

(62)m=	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21	

Output from water heater (annual)1…12 1941.45 (64)

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

(65)m=	60.97	53.28	55.34	48.92	47.28	41.48	39.5	44.27	44.76	51.2	54.89	59.45	(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=	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	(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	8.84	11.87	15.07	17.59	18.75	(67)

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

(68)m=	204.67	206.79	201.44	190.05	175.67	162.15	153.12	150.99	156.35	167.74	182.12	195.64	(68)

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

(69)m=	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	(71)

Water heating gains (Table 5)

(72)m=	81.95	79.28	74.38	67.94	63.55	57.61	53.09	59.5	62.17	68.81	76.23	79.9	(72)

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

(73)m=	365.69	363.1	349.83	328.79	307.5	286.88	273.83	280.16	291.21	312.45	336.77	355.11	(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)	
Southeast	0.9x	0.77	x	13.33	x	36.79	x	0.63	x	0.7	=	149.89	(77)
Southeast	0.9x	0.77	x	13.33	x	62.67	x	0.63	x	0.7	=	255.32	(77)
Southeast	0.9x	0.77	x	13.33	x	85.75	x	0.63	x	0.7	=	349.34	(77)
Southeast	0.9x	0.77	x	13.33	x	106.25	x	0.63	x	0.7	=	432.85	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	13.33	x	119.01	x	0.63	x	0.7	=	484.83	(77)
Southeast	0.9x	0.77	x	13.33	x	118.15	x	0.63	x	0.7	=	481.32	(77)
Southeast	0.9x	0.77	x	13.33	x	113.91	x	0.63	x	0.7	=	464.05	(77)
Southeast	0.9x	0.77	x	13.33	x	104.39	x	0.63	x	0.7	=	425.27	(77)
Southeast	0.9x	0.77	x	13.33	x	92.85	x	0.63	x	0.7	=	378.26	(77)
Southeast	0.9x	0.77	x	13.33	x	69.27	x	0.63	x	0.7	=	282.18	(77)
Southeast	0.9x	0.77	x	13.33	x	44.07	x	0.63	x	0.7	=	179.54	(77)
Southeast	0.9x	0.77	x	13.33	x	31.49	x	0.63	x	0.7	=	128.28	(77)
Northwest	0.9x	0.77	x	5.64	x	11.28	x	0.63	x	0.7	=	19.45	(81)
Northwest	0.9x	0.77	x	5.64	x	22.97	x	0.63	x	0.7	=	39.59	(81)
Northwest	0.9x	0.77	x	5.64	x	41.38	x	0.63	x	0.7	=	71.32	(81)
Northwest	0.9x	0.77	x	5.64	x	67.96	x	0.63	x	0.7	=	117.13	(81)
Northwest	0.9x	0.77	x	5.64	x	91.35	x	0.63	x	0.7	=	157.45	(81)
Northwest	0.9x	0.77	x	5.64	x	97.38	x	0.63	x	0.7	=	167.86	(81)
Northwest	0.9x	0.77	x	5.64	x	91.1	x	0.63	x	0.7	=	157.03	(81)
Northwest	0.9x	0.77	x	5.64	x	72.63	x	0.63	x	0.7	=	125.18	(81)
Northwest	0.9x	0.77	x	5.64	x	50.42	x	0.63	x	0.7	=	86.91	(81)
Northwest	0.9x	0.77	x	5.64	x	28.07	x	0.63	x	0.7	=	48.38	(81)
Northwest	0.9x	0.77	x	5.64	x	14.2	x	0.63	x	0.7	=	24.47	(81)
Northwest	0.9x	0.77	x	5.64	x	9.21	x	0.63	x	0.7	=	15.88	(81)

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

(83)m=	169.34	294.91	420.66	549.98	642.28	649.18	621.07	550.45	465.17	330.56	204.01	144.16	(83)

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

(84)m=	535.03	658.01	770.49	878.77	949.77	936.06	894.9	830.61	756.38	643.01	540.77	499.27	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.96	0.88	0.72	0.53	0.38	0.43	0.68	0.93	0.99	1	(86)

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

(87)m=	19.93	20.15	20.44	20.75	20.93	20.99	21	21	20.96	20.7	20.25	19.9	(87)

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

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

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

(89)m=	0.99	0.98	0.95	0.84	0.66	0.45	0.3	0.34	0.6	0.9	0.98	1	(89)

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

(90)m=	18.59	18.9	19.31	19.74	19.95	20.02	20.02	20.02	19.99	19.69	19.06	18.54	(90)

fLA = Living area ÷ (4) = 0.41 (91)

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

(92)m=	19.14	19.41	19.77	20.15	20.35	20.41	20.42	20.42	20.39	20.1	19.55	19.09	(92)

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

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	18.99	19.26	19.62	20	20.2	20.26	20.27	20.27	20.24	19.95	19.4	18.94		(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.94	0.84	0.67	0.47	0.32	0.36	0.62	0.89	0.98	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	530.34	642.67	723.93	740.63	638.76	440.32	287.9	302.52	466.78	575.19	529.89	496.08		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1193.16	1163.44	1059.96	884.47	675.56	444.83	288.37	303.42	484.26	743.19	982.46	1184.2		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	493.14	349.96	250.01	103.56	27.38	0	0	0	0	125	325.86	511.96		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2186.87	(98)
Space heating requirement in kWh/m²/year													29.87	(99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		96.8	(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)														
	493.14	349.96	250.01	103.56	27.38	0	0	0	0	125	325.86	511.96		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	509.44	361.53	258.27	106.99	28.29	0	0	0	0	129.13	336.63	528.89		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2259.16	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	195.81	171.04	177.96	157.84	152.82	134.59	128.95	143.75	145.34	165.49	176.66	191.21		
Efficiency of water heater													87.5	(216)
(217)m=	93.96	93.54	92.7	90.96	88.8	87.5	87.5	87.5	87.5	91.27	93.31	94.08		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	208.39	182.86	191.97	173.52	172.1	153.82	147.37	164.28	166.1	181.32	189.32	203.24		
Total = Sum(219a)$_{1...12}$ =													2134.28	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2259.16

Water heating fuel used			2134.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			322.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4745.68	(338)

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	=	487.98	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	461	(264)
Space and water heating	(261) + (262) + (263) + (264) =			948.98	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	167.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		1131.79	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.46	(273)
EI rating (section 14)				87	(274)

SAP Input

Property Details: SF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	Storey height:
Floor 0	59.71 m²	2.5 m
Living area:	20.52 m² (fraction 0.344)	
Front of dwelling faces:	South East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
se	Manufacturer	Solid			
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
se	mm	0.7	0.63	1.6	1.89	1
nw	16mm or more	0.7	0.63	1.3	12.93	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
se		Shel	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	29.43	12.93	16.5	0.24	0	False	N/A
Shel	25.2	1.89	23.31	0.11	0.43	False	N/A
Flat Roof	59.71	0	59.71	0.12	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0696

Length	Psi-value		
6.71	0.05	E2	Other lintels (including other steel lintels)
21.94	0.04	E4	Jamb
7.5	0.058	E16	Corner (normal)

SAP Input

5	-0.069	E17	Corner (inverted internal area greater than external area)
7.5	0.068	E18	Party wall between dwellings
21.85	0.073	E7	Party floor between dwellings (in blocks of flats)
21.85	0.08	E14	Flat roof
11.69	0	P3	Intermediate floor between dwellings (in blocks of flats)
11.69	0.24	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Boiler systems with radiators or underfloor heating Gas boilers and oil boilers Fuel: mains gas Info Source: Manufacturer Declaration Manufacturer's data Efficiency: 97.0% (SEDBUK2009) Condensing combi with automatic ignition Fuel Burning Type: Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Unknown Boiler interlock: Yes Delayed start

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :mains gas No hot water cylinder Flue Gas Heat Recovery System: Database (rev 512, product index) Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP Input

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: SF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.71	(1a) x	2.5	(2a) =	149.27	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.71	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.27	(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) =	0.2	(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)	0.45	(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) =	0.38	(21)

Infiltration rate modified for monthly wind speed

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

SAP WorkSheet: New dwelling design stage

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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows			12.93	x1/[1/(1.3)+ 0.04]		=	15.98			(27)
Walls Type1	29.43	12.93	16.5	x	0.24	=	3.96			(29)
Walls Type2	25.2	1.89	23.31	x	0.11	=	2.45			(29)
Roof	59.71	0	59.71	x	0.12	=	7.17			(30)
Total area of elements, m²			114.34							(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) = 32.58 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 537.39 (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 7.96 (36)

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

Total fabric heat loss (33) + (36) = 40.54 (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=	30.51	30.29	30.06	29.01	28.81	27.9	27.9	27.73	28.25	28.81	29.21	29.63	(38)

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

(39)m=	71.05	70.82	70.6	69.55	69.35	68.43	68.43	68.26	68.79	69.35	69.75	70.16	

Average = Sum(39)$_{1\ldots12}$ /12= 69.55 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.19	1.19	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.17	1.18

Average = $Sum(40)_{1...12}$ /12= 1.16 (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 1.97 (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 81.07 (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=	89.18	85.93	82.69	79.45	76.2	72.96	72.96	76.2	79.45	82.69	85.93	89.18	
										Total = $Sum(44)_{1...12}$ =		972.83	(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=	132.24	115.66	119.35	104.05	99.84	86.16	79.84	91.61	92.71	108.04	117.94	128.07	
										Total = $Sum(45)_{1...12}$ =		1275.53	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.84	17.35	17.9	15.61	14.98	12.92	11.98	13.74	13.91	16.21	17.69	19.21	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

SAP WorkSheet: New dwelling design stage

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

(61)m=	45.44	39.55	42.14	39.18	38.83	35.98	37.18	38.83	39.18	42.14	42.38	45.44	(61)

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

(62)m=	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52	

Output from water heater (annual)$_{1...12}$ 1761.81 (64)

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

(65)m=	55.33	48.35	50.22	44.39	42.91	37.64	35.84	40.17	40.62	46.46	49.81	53.94	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	(66)

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

(67)m=	38.42	34.12	27.75	21.01	15.7	13.26	14.33	18.62	24.99	31.74	37.04	39.49	(67)

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

(68)m=	257.04	259.7	252.98	238.67	220.61	203.64	192.29	189.63	196.35	210.66	228.72	245.7	(68)

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

(69)m=	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	(71)

Water heating gains (Table 5)

(72)m=	74.37	71.94	67.5	61.66	57.67	52.28	48.17	53.99	56.42	62.44	69.18	72.51	(72)

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

(73)m=	461.11	457.05	439.52	412.62	385.27	360.46	346.08	353.52	369.04	396.12	426.22	448.97	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest	0.9x	0.77	x	12.93	x	11.28	x	0.63	x	0.7	=	44.59	(81)
Northwest	0.9x	0.77	x	12.93	x	22.97	x	0.63	x	0.7	=	90.75	(81)
Northwest	0.9x	0.77	x	12.93	x	41.38	x	0.63	x	0.7	=	163.51	(81)
Northwest	0.9x	0.77	x	12.93	x	67.96	x	0.63	x	0.7	=	268.53	(81)

SAP WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	12.93	x	91.35	x	0.63	x	0.7	=	360.96	(81)
Northwest	0.9x	0.77	x	12.93	x	97.38	x	0.63	x	0.7	=	384.82	(81)
Northwest	0.9x	0.77	x	12.93	x	91.1	x	0.63	x	0.7	=	359.99	(81)
Northwest	0.9x	0.77	x	12.93	x	72.63	x	0.63	x	0.7	=	286.99	(81)
Northwest	0.9x	0.77	x	12.93	x	50.42	x	0.63	x	0.7	=	199.24	(81)
Northwest	0.9x	0.77	x	12.93	x	28.07	x	0.63	x	0.7	=	110.91	(81)
Northwest	0.9x	0.77	x	12.93	x	14.2	x	0.63	x	0.7	=	56.1	(81)
Northwest	0.9x	0.77	x	12.93	x	9.21	x	0.63	x	0.7	=	36.41	(81)

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

(83)m=	44.59	90.75	163.51	268.53	360.96	384.82	359.99	286.99	199.24	110.91	56.1	36.41	(83)

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

(84)m=	505.7	547.81	603.03	681.16	746.23	745.28	706.07	640.51	568.28	507.03	482.32	485.38	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.91	0.77	0.57	0.42	0.48	0.75	0.94	0.98	0.99	(86)

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

(87)m=	19.93	20.06	20.31	20.65	20.89	20.98	21	20.99	20.92	20.62	20.22	19.91	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	0.99	0.98	0.96	0.88	0.71	0.49	0.33	0.38	0.67	0.92	0.98	0.99	(89)

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

(90)m=	18.53	18.72	19.08	19.56	19.85	19.95	19.96	19.96	19.9	19.53	18.97	18.51	(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	19.01	19.18	19.51	19.93	20.2	20.3	20.32	20.32	20.25	19.9	19.4	18.99	(92)

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

(93)m=	18.86	19.03	19.36	19.78	20.05	20.15	20.17	20.17	20.1	19.75	19.25	18.84	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.95	0.87	0.71	0.5	0.34	0.4	0.68	0.91	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	497.78	534.53	573.26	594.84	532.39	373.75	243.38	255.61	386.38	462.02	469.21	479	(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=	1034.65	1001.02	907.66	756.87	579.42	380.12	244.14	257.15	413.03	634.77	847.58	1027.24	(97)

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

(98)m=	399.43	313.48	248.79	116.67	34.99	0	0	0	0	128.52	272.43	407.89

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1922.21 (98)

Space heating requirement in kWh/m²/year 32.19 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		97.8	(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)	399.43	313.48	248.79	116.67	34.99	0	0	0	0	128.52	272.43	407.89		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	408.42	320.54	254.39	119.29	35.77	0	0	0	0	131.41	278.56	417.07		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1965.45	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52		
Efficiency of water heater													88.5	(216)
(217)m=	94.73	94.51	93.92	92.45	90.23	88.5	88.5	88.5	88.5	92.56	94.14	94.83		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	187.56	164.23	171.95	154.94	153.69	138.01	132.22	147.4	149.03	162.25	170.3	182.98		
Total = Sum(219a)$_{1...12}$ =													1914.58	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1965.45	
Water heating fuel used			1914.58	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			271.4	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4181.42	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

Space heating - main system 1	(211) x		3.48	x 0.01 =	68.4	(240)
Space heating - main system 2	(213) x		0	x 0.01 =	0	(241)
Space heating - secondary	(215) x		13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	66.63	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	3.96	(249)

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

Energy for lighting	(232)		13.19	x 0.01 =	35.8	(250)
Additional standing charges (Table 12)					120	(251)

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

Total energy cost	(245)...(247) + (250)...(254) =	294.78	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.18	(257)
SAP rating (Section 12)		83.51	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	424.54	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	413.55	(264)
Space and water heating	(261) + (262) + (263) + (264) =			838.08	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	140.86	(268)
Total CO2, kg/year		sum of (265)…(271) =		994.51	(272)
CO2 emissions per m²		(272) ÷ (4) =		16.66	(273)
EI rating (section 14)				87	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2397.84	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2335.78	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4733.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	833.2	(268)
'Total Primary Energy		sum of (265)…(271) =		5658.92	(272)

SAP WorkSheet: New dwelling design stage

Primary energy kWh/m²/year	(272) ÷ (4) =	94.77	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: SF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.71	(1a) x	2.5	(2a) =	149.27	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.71	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		149.27	(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) =	0.2	(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)	0.45	(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) =	0.38	(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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows			12.93	x1/[1/(1.3)+ 0.04]		=	15.98			(27)
Walls Type1	29.43	12.93	16.5	x	0.24	=	3.96			(29)
Walls Type2	25.2	1.89	23.31	x	0.11	=	2.45			(29)
Roof	59.71	0	59.71	x	0.12	=	7.17			(30)
Total area of elements, m²			114.34							(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) = 32.58 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 537.39 (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 7.96 (36)

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

Total fabric heat loss (33) + (36) = 40.54 (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=	30.51	30.29	30.06	29.01	28.81	27.9	27.9	27.73	28.25	28.81	29.21	29.63	(38)

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

(39)m=	71.05	70.82	70.6	69.55	69.35	68.43	68.43	68.26	68.79	69.35	69.75	70.16	

Average = $Sum(39)_{1…12}$ /12= 69.55 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	1.19	1.19	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.17	1.18

Average = Sum(40)$_{1\ldots12}$ /12= 1.16 (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 1.97 (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 81.07 (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=	89.18	85.93	82.69	79.45	76.2	72.96	72.96	76.2	79.45	82.69	85.93	89.18	
										Total = Sum(44)$_{1\ldots12}$ =		972.83	(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=	132.24	115.66	119.35	104.05	99.84	86.16	79.84	91.61	92.71	108.04	117.94	128.07	
										Total = Sum(45)$_{1\ldots12}$ =		1275.53	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.84	17.35	17.9	15.61	14.98	12.92	11.98	13.74	13.91	16.21	17.69	19.21	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	45.44	39.55	42.14	39.18	38.83	35.98	37.18	38.83	39.18	42.14	42.38	45.44	(61)

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

(62)m=	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52	

Output from water heater (annual)$_{1...12}$ 1761.81 (64)

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

(65)m=	55.33	48.35	50.22	44.39	42.91	37.64	35.84	40.17	40.62	46.46	49.81	53.94	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	(66)

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

(67)m=	15.37	13.65	11.1	8.4	6.28	5.3	5.73	7.45	10	12.69	14.82	15.79	(67)

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

(68)m=	172.21	174	169.5	159.91	147.81	136.44	128.84	127.05	131.55	141.14	153.24	164.62	(68)

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

(69)m=	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	(71)

Water heating gains (Table 5)

(72)m=	74.37	71.94	67.5	61.66	57.67	52.28	48.17	53.99	56.42	62.44	69.18	72.51	(72)

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

(73)m=	317.56	315.2	303.7	285.57	267.36	249.62	238.34	244.09	253.57	271.88	292.84	308.52	(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)	
Northwest	0.9x	0.77	x	12.93	x	11.28	x	0.63	x	0.7	=	44.59	(81)
Northwest	0.9x	0.77	x	12.93	x	22.97	x	0.63	x	0.7	=	90.75	(81)
Northwest	0.9x	0.77	x	12.93	x	41.38	x	0.63	x	0.7	=	163.51	(81)
Northwest	0.9x	0.77	x	12.93	x	67.96	x	0.63	x	0.7	=	268.53	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	12.93	x	91.35	x	0.63	x	0.7	=	360.96	(81)
Northwest	0.9x	0.77	x	12.93	x	97.38	x	0.63	x	0.7	=	384.82	(81)
Northwest	0.9x	0.77	x	12.93	x	91.1	x	0.63	x	0.7	=	359.99	(81)
Northwest	0.9x	0.77	x	12.93	x	72.63	x	0.63	x	0.7	=	286.99	(81)
Northwest	0.9x	0.77	x	12.93	x	50.42	x	0.63	x	0.7	=	199.24	(81)
Northwest	0.9x	0.77	x	12.93	x	28.07	x	0.63	x	0.7	=	110.91	(81)
Northwest	0.9x	0.77	x	12.93	x	14.2	x	0.63	x	0.7	=	56.1	(81)
Northwest	0.9x	0.77	x	12.93	x	9.21	x	0.63	x	0.7	=	36.41	(81)

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

(83)m=	44.59	90.75	163.51	268.53	360.96	384.82	359.99	286.99	199.24	110.91	56.1	36.41	(83)

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

(84)m=	362.14	405.95	467.21	554.11	628.32	634.44	598.34	531.08	452.81	382.79	348.94	344.93	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.95	0.84	0.65	0.5	0.57	0.85	0.98	1	1	(86)

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

(87)m=	19.71	19.85	20.12	20.51	20.82	20.96	20.99	20.99	20.86	20.46	20.02	19.69	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	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	0.79	0.56	0.38	0.45	0.78	0.97	0.99	1	(89)

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

(90)m=	18.21	18.42	18.82	19.37	19.78	19.94	19.96	19.96	19.85	19.31	18.69	18.2	(90)

fLA = Living area ÷ (4) = | 0.34 | (91)

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

(92)m=	18.73	18.91	19.26	19.76	20.14	20.29	20.32	20.31	20.19	19.71	19.15	18.71	(92)

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

(93)m=	18.58	18.76	19.11	19.61	19.99	20.14	20.17	20.16	20.04	19.56	19	18.56	(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	0.79	0.58	0.41	0.48	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	360.63	402.8	457.68	514.88	498.71	367.29	242.41	253.39	357.11	368.87	346.18	343.79	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1014.53	981.65	890.53	745.15	574.69	379.23	243.99	256.82	408.91	621.1	829.69	1007.64	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(98)m=	486.51	388.99	322.04	165.8	56.53	0	0	0	0	187.65	348.13	493.9

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2449.54 (98)

Space heating requirement in kWh/m²/year 41.02 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		97.8	(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)	486.51	388.99	322.04	165.8	56.53	0	0	0	0	187.65	348.13	493.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	497.45	397.74	329.29	169.53	57.8	0	0	0	0	191.87	355.96	505.01	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2504.64 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

	177.69	155.21	161.49	143.23	138.68	122.14	117.02	130.45	131.89	150.18	160.32	173.52

Efficiency of water heater 88.5 (216)

(217)m=	95.13	94.95	94.48	93.26	91.01	88.5	88.5	88.5	88.5	93.44	94.66	95.2	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	186.79	163.46	170.92	153.59	152.38	138.01	132.22	147.4	149.03	160.73	169.35	182.27

Total = Sum(219a)$_{1...12}$ = 1906.15 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2504.64	
Water heating fuel used			1906.15	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			271.4	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			4712.2	(338)

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

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

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.216	=	541	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	411.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			952.73	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	140.86	(268)
Total CO2, kg/year		sum of (265)…(271) =		1109.16	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		18.58	(273)
EI rating (section 14)				86	(274)

Appendix 2

Sample SAP Reports – Be Green

SAP Input

Property Details: GF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	Storey height:
Floor 0	60.29 m²	2.5 m
Living area:	25.32 m² (fraction 0.42)	
Front of dwelling faces:	South East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
se	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
se	16mm or more	0.7	0.63	1.3	3.33	1
nw	16mm or more	0.7	0.63	1.3	6.15	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
se		Ext.	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	52.77	9.48	43.29	0.24	0	False	N/A
Shel	22.8	0	22.8	0.11	0.43	False	N/A
Flat	8.04	0	8.04	0.12	0		N/A
GF	60.29			0.12			N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0498

Length	**Psi-value**		
5.14	0.05	E2	Other lintels (including other steel lintels)
1.42	0.034	E3	Sill

SAP Input

15.06	0.04	E4	Jamb
30.23	0.079	E5	Ground floor (normal)
8.88	0.08	E14	Flat roof
2.5	0.058	E16	Corner (normal)
5	-0.069	E17	Corner (inverted internal area greater than external area)
12.5	0.068	E18	Party wall between dwellings
12.99	0.16	P1	Ground floor
1.81	0.24	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	2
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:

Heat pumps with radiators or underfloor heating
Electric heat pumps
Fuel: Electricity
Info Source: Boiler Database
Database: (rev 512, product index 101403, SEDBUK 216%):
Brand name: Vaillant
Model: aroTHERM
Model qualifier: VWL 85/2 - Underfloor
(provides DHW all year)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2207

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :Electricity
Hot water cylinder
Cylinder volume: 90 litres
Cylinder insulation: Measured loss, 0.85kWh/day
Primary pipework insulation: True
Cylinderstat: True
Cylinder in heated space: True
Flue Gas Heat Recovery System:
Database (rev 512, product index)
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown

SAP Input

Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: GF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	60.29	(1a)	x	2.5	(2a)	=	150.73	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.29	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			150.73	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

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

SAP 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	0.33	0.35	0.37	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.33	x1/[1/(1.3)+ 0.04]		=	4.12			(27)
Windows Type 2			6.15	x1/[1/(1.3)+ 0.04]		=	7.6			(27)
Floor			60.29	x	0.12	=	7.2348			(28)
Walls Type1	52.77	9.48	43.29	x	0.24	=	10.39			(29)
Walls Type2	22.8	0	22.8	x	0.11	=	2.39			(29)
Roof	8.04	0	8.04	x	0.12	=	0.96			(30)
Total area of elements, m²			143.9							(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) = 32.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 72.36 (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 7.17 (36)

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

Total fabric heat loss (33) + (36) = 39.87 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.15	28.98	28.82	28.05	27.91	27.24	27.24	27.12	27.5	27.91	28.2	28.5	(38)

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

(39)m=	69.02	68.85	68.69	67.92	67.78	67.11	67.11	66.99	67.37	67.78	68.07	68.37	

Average = Sum(39)$_{1…12}$ /12= 67.92 (39)

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

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

Average = Sum(40)$_{1…12}$ /12= 1.13 (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 1.99 (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 81.46 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	89.6	86.35	83.09	79.83	76.57	73.31	73.31	76.57	79.83	83.09	86.35	89.6

Total = Sum(44)$_{1…12}$ = 977.5 (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=	132.88	116.22	119.93	104.55	100.32	86.57	80.22	92.05	93.15	108.56	118.5	128.69

Total = Sum(45)$_{1…12}$ = 1281.66 (45)

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

(46)m=	19.93	17.43	17.99	15.68	15.05	12.99	12.03	13.81	13.97	16.28	17.78	19.3

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23

(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23

(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=	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18	

Output from water heater (annual)1…12 | 1723.09 | (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=	74.18	65.73	69.87	63.79	63.35	57.81	56.67	60.6	60	66.09	68.43	72.78	(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=	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	119.39	(66)

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

(67)m=	40.52	35.99	29.27	22.16	16.57	13.99	15.11	19.64	26.36	33.48	39.07	41.65	(67)

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

(68)m=	259.22	261.91	255.13	240.7	222.49	205.37	193.93	191.24	198.02	212.45	230.66	247.78	(68)

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

(69)m=	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	48.93	(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=	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	(71)

Water heating gains (Table 5)

(72)m=	99.7	97.82	93.91	88.6	85.15	80.29	76.16	81.45	83.33	88.83	95.04	97.82	(72)

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

(73)m=	488.17	484.45	467.04	440.18	412.92	388.37	373.93	381.06	396.44	423.48	453.5	475.98	(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)	
Southeast	0.9x	0.77	x	3.33	x	36.79	x	0.63	x	0.7	=	37.44	(77)
Southeast	0.9x	0.77	x	3.33	x	62.67	x	0.63	x	0.7	=	63.78	(77)
Southeast	0.9x	0.77	x	3.33	x	85.75	x	0.63	x	0.7	=	87.27	(77)
Southeast	0.9x	0.77	x	3.33	x	106.25	x	0.63	x	0.7	=	108.13	(77)

Southeast 0.9x	0.77	x	3.33	x	119.01	x	0.63	x	0.7	=	121.12	(77)
Southeast 0.9x	0.77	x	3.33	x	118.15	x	0.63	x	0.7	=	120.24	(77)
Southeast 0.9x	0.77	x	3.33	x	113.91	x	0.63	x	0.7	=	115.92	(77)
Southeast 0.9x	0.77	x	3.33	x	104.39	x	0.63	x	0.7	=	106.24	(77)
Southeast 0.9x	0.77	x	3.33	x	92.85	x	0.63	x	0.7	=	94.49	(77)
Southeast 0.9x	0.77	x	3.33	x	69.27	x	0.63	x	0.7	=	70.49	(77)
Southeast 0.9x	0.77	x	3.33	x	44.07	x	0.63	x	0.7	=	44.85	(77)
Southeast 0.9x	0.77	x	3.33	x	31.49	x	0.63	x	0.7	=	32.04	(77)
Northwest 0.9x	0.77	x	6.15	x	11.28	x	0.63	x	0.7	=	21.21	(81)
Northwest 0.9x	0.77	x	6.15	x	22.97	x	0.63	x	0.7	=	43.17	(81)
Northwest 0.9x	0.77	x	6.15	x	41.38	x	0.63	x	0.7	=	77.77	(81)
Northwest 0.9x	0.77	x	6.15	x	67.96	x	0.63	x	0.7	=	127.72	(81)
Northwest 0.9x	0.77	x	6.15	x	91.35	x	0.63	x	0.7	=	171.69	(81)
Northwest 0.9x	0.77	x	6.15	x	97.38	x	0.63	x	0.7	=	183.04	(81)
Northwest 0.9x	0.77	x	6.15	x	91.1	x	0.63	x	0.7	=	171.23	(81)
Northwest 0.9x	0.77	x	6.15	x	72.63	x	0.63	x	0.7	=	136.5	(81)
Northwest 0.9x	0.77	x	6.15	x	50.42	x	0.63	x	0.7	=	94.77	(81)
Northwest 0.9x	0.77	x	6.15	x	28.07	x	0.63	x	0.7	=	52.75	(81)
Northwest 0.9x	0.77	x	6.15	x	14.2	x	0.63	x	0.7	=	26.68	(81)
Northwest 0.9x	0.77	x	6.15	x	9.21	x	0.63	x	0.7	=	17.32	(81)

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

(83)m=	58.65	106.95	165.04	235.86	292.8	303.28	287.15	242.74	189.26	123.25	71.53	49.36	(83)

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

(84)m=	546.82	591.39	632.08	676.04	705.73	691.64	661.08	623.8	585.7	546.72	525.03	525.35	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.79	0.6	0.44	0.49	0.73	0.92	0.98	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(88)

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

(89)m=	0.98	0.97	0.95	0.88	0.73	0.51	0.34	0.38	0.64	0.89	0.97	0.99	(89)

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

(90)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.42	20.41	20.41	20.41	20.4	(92)

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

SAP WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(93)m=	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.42	20.41	20.41	20.41	20.4		(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.95	0.89	0.75	0.55	0.39	0.43	0.68	0.91	0.97	0.99		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	538.94	577.66	603.27	602.05	532.06	381.06	254.8	266.98	399.14	495.57	510.85	519.05		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1111.1	1067.21	954.87	781.63	590.28	390.21	255.98	268.97	425.25	664.84	905.76	1107.9		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	425.69	328.97	261.6	129.3	43.32	0	0	0	0	125.93	284.34	438.11		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				2037.25	(98)
Space heating requirement in kWh/m²/year													33.79	(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		216.37	(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)														
	425.69	328.97	261.6	129.3	43.32	0	0	0	0	125.93	284.34	438.11		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	196.74	152.04	120.9	59.76	20.02	0	0	0	0	58.2	131.41	202.48		
									Total (kWh/year) =Sum(211)$_{1...5,10...12}$=				941.57	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10...12}$=				0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)														
	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	146.67	129.2	135.52	121.24	118.64	105.76	101.34	111.52	111.43	125.73	133.25	143.06		
									Total = Sum(219a)$_{1...12}$ =				1483.37	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		941.57

SAP WorkSheet: New dwelling design stage

Water heating fuel used			1483.37	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			286.27	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2711.22	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	124.19	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	195.66	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	0	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	37.76	(250)
Additional standing charges (Table 12)				0	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	357.61	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.43	(257)
SAP rating (Section 12)		80.1	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	488.68	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	769.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1258.55	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	148.57	(268)
Total CO2, kg/year		sum of (265)…(271) =		1407.12	(272)
CO2 emissions per m²		(272) ÷ (4) =		23.34	(273)
EI rating (section 14)				82	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2890.63	(261)

SAP WorkSheet: New dwelling design stage

Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	4553.96	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7444.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0	(267)
Electricity for lighting	(232) x	0	=	878.84	(268)
'Total Primary Energy	sum of (265)…(271) =			8323.43	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			138.06	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: GF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	60.29	(1a) x	2.5	(2a) =	150.73	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	60.29	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	150.73	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.13	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

Infiltration rate modified for monthly wind speed

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

DER 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	0.33	0.35	0.37	0.38

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.33	x1/[1/(1.3)+ 0.04]		=	4.12			(27)
Windows Type 2			6.15	x1/[1/(1.3)+ 0.04]		=	7.6			(27)
Floor			60.29	x	0.12	=	7.2348			(28)
Walls Type1	52.77	9.48	43.29	x	0.24	=	10.39			(29)
Walls Type2	22.8	0	22.8	x	0.11	=	2.39			(29)
Roof	8.04	0	8.04	x	0.12	=	0.96			(30)
Total area of elements, m²			143.9							(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) = 32.7 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 72.36 (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 7.17 (36)

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

Total fabric heat loss (33) + (36) = 39.87 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	29.15	28.98	28.82	28.05	27.91	27.24	27.24	27.12	27.5	27.91	28.2	28.5	(38)

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

(39)m=	69.02	68.85	68.69	67.92	67.78	67.11	67.11	66.99	67.37	67.78	68.07	68.37	

Average = Sum(39)$_{1\ldots12}$ /12= 67.92 (39)

DER WorkSheet: New dwelling design stage

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

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

Average = Sum(40)$_{1…12}$ /12= 1.13 (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 1.99 (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 81.46 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	89.6	86.35	83.09	79.83	76.57	73.31	73.31	76.57	79.83	83.09	86.35	89.6	
										Total = Sum(44)$_{1…12}$ =		977.5	(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=	132.88	116.22	119.93	104.55	100.32	86.57	80.22	92.05	93.15	108.56	118.5	128.69	
										Total = Sum(45)$_{1…12}$ =		1281.66	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	19.93	17.43	17.99	15.68	15.05	12.99	12.03	13.81	13.97	16.28	17.78	19.3	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18	

Output from water heater (annual)$_{1...12}$ 1723.09 (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=	74.18	65.73	69.87	63.79	63.35	57.81	56.67	60.6	60	66.09	68.43	72.78	(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=	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	(66)

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

(67)m=	16.21	14.4	11.71	8.86	6.63	5.59	6.04	7.86	10.55	13.39	15.63	16.66	(67)

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

(68)m=	173.68	175.48	170.94	161.27	149.07	137.59	129.93	128.13	132.67	142.34	154.54	166.01	(68)

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

(69)m=	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	32.95	(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=	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	-79.59	(71)

Water heating gains (Table 5)

(72)m=	99.7	97.82	93.91	88.6	85.15	80.29	76.16	81.45	83.33	88.83	95.04	97.82	(72)

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

(73)m=	342.43	340.54	329.4	311.58	293.69	276.33	264.99	270.29	279.4	297.41	318.06	333.35	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	3.33	x	36.79	x	0.63	x	0.7	=	37.44	(77)
Southeast 0.9x	0.77	x	3.33	x	62.67	x	0.63	x	0.7	=	63.78	(77)
Southeast 0.9x	0.77	x	3.33	x	85.75	x	0.63	x	0.7	=	87.27	(77)
Southeast 0.9x	0.77	x	3.33	x	106.25	x	0.63	x	0.7	=	108.13	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	3.33	x	119.01	x	0.63	x	0.7	=	121.12	(77)
Southeast	0.9x	0.77	x	3.33	x	118.15	x	0.63	x	0.7	=	120.24	(77)
Southeast	0.9x	0.77	x	3.33	x	113.91	x	0.63	x	0.7	=	115.92	(77)
Southeast	0.9x	0.77	x	3.33	x	104.39	x	0.63	x	0.7	=	106.24	(77)
Southeast	0.9x	0.77	x	3.33	x	92.85	x	0.63	x	0.7	=	94.49	(77)
Southeast	0.9x	0.77	x	3.33	x	69.27	x	0.63	x	0.7	=	70.49	(77)
Southeast	0.9x	0.77	x	3.33	x	44.07	x	0.63	x	0.7	=	44.85	(77)
Southeast	0.9x	0.77	x	3.33	x	31.49	x	0.63	x	0.7	=	32.04	(77)
Northwest	0.9x	0.77	x	6.15	x	11.28	x	0.63	x	0.7	=	21.21	(81)
Northwest	0.9x	0.77	x	6.15	x	22.97	x	0.63	x	0.7	=	43.17	(81)
Northwest	0.9x	0.77	x	6.15	x	41.38	x	0.63	x	0.7	=	77.77	(81)
Northwest	0.9x	0.77	x	6.15	x	67.96	x	0.63	x	0.7	=	127.72	(81)
Northwest	0.9x	0.77	x	6.15	x	91.35	x	0.63	x	0.7	=	171.69	(81)
Northwest	0.9x	0.77	x	6.15	x	97.38	x	0.63	x	0.7	=	183.04	(81)
Northwest	0.9x	0.77	x	6.15	x	91.1	x	0.63	x	0.7	=	171.23	(81)
Northwest	0.9x	0.77	x	6.15	x	72.63	x	0.63	x	0.7	=	136.5	(81)
Northwest	0.9x	0.77	x	6.15	x	50.42	x	0.63	x	0.7	=	94.77	(81)
Northwest	0.9x	0.77	x	6.15	x	28.07	x	0.63	x	0.7	=	52.75	(81)
Northwest	0.9x	0.77	x	6.15	x	14.2	x	0.63	x	0.7	=	26.68	(81)
Northwest	0.9x	0.77	x	6.15	x	9.21	x	0.63	x	0.7	=	17.32	(81)

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

(83)m=	58.65	106.95	165.04	235.86	292.8	303.28	287.15	242.74	189.26	123.25	71.53	49.36	(83)

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

(84)m=	401.08	447.49	494.45	547.43	586.49	579.6	552.14	513.03	468.66	420.65	389.59	382.71	(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	0.99	0.99	0.95	0.87	0.69	0.52	0.58	0.83	0.97	0.99	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(88)

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

(89)m=	1	0.99	0.98	0.94	0.82	0.6	0.41	0.46	0.76	0.96	0.99	1	(89)

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

(90)m=	19.96	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.97	(90)

fLA = Living area ÷ (4) = 0.42 (91)

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

(92)m=	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.42	20.41	20.41	20.41	20.4	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.42	20.41	20.41	20.41	20.4	(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=	1	0.99	0.98	0.95	0.84	0.64	0.46	0.52	0.79	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	399.58	444.26	485.77	517.45	492.2	372.06	253.36	264.34	372.11	404.85	386.57	381.58	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1111.1	1067.21	954.87	781.63	590.28	390.21	255.98	268.97	425.25	664.84	905.76	1107.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	529.37	418.62	349.01	190.22	72.97	0	0	0	0	193.43	373.82	540.38	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2667.82 (98)

Space heating requirement in kWh/m²/year 44.25 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		216.37	(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)														
	529.37	418.62	349.01	190.22	72.97	0	0	0	0	193.43	373.82	540.38		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	244.66	193.48	161.3	87.91	33.73	0	0	0	0	89.4	172.77	249.75		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1233.01	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	170.37	150.08	157.42	140.84	137.81	122.85	117.71	129.55	129.44	146.05	154.79	166.18		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	146.67	129.2	135.52	121.24	118.64	105.76	101.34	111.52	111.43	125.73	133.25	143.06		
Total = Sum(219a)$_{1...12}$ =													1483.37	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1233.01

DER WorkSheet: New dwelling design stage

Water heating fuel used		1483.37	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	0	(231)
Electricity for lighting		286.27	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		3002.65	(338)

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	0.519	=	639.93	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	769.87	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1409.8	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	148.57	(268)
Total CO2, kg/year			sum of (265)…(271) =		1558.38	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		25.85	(273)
EI rating (section 14)					80	(274)

SAP Input

Property Details: FF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	Storey height:
Floor 0	73.21 m²	2.5 m
Living area:	29.99 m² (fraction 0.41)	
Front of dwelling faces:	North East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
ne	Manufacturer	Solid			Wood
se	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
ne	mm	0.7	0.63	1.6	1.89	1
se	16mm or more	0.7	0.63	1.3	13.33	1
nw	16mm or more	0.7	0.63	1.3	5.64	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
ne		Shel	North East	0	0
se		Ext.	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	71.92	18.97	52.95	0.24	0	False	N/A
Shel	13.03	1.89	11.14	0.11	0.43	False	N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0543

Length	**Psi-value**		
10.42	0.05	E2	Other lintels (including other steel lintels)

SAP Input

	2.04	0.034	E3	Sill
	24.04	0.04	E4	Jamb
	10	0.058	E16	Corner (normal)
	2.5	-0.069	E17	Corner (inverted internal area greater than external area)
	2.5	0.068	E18	Party wall between dwellings
	33.98	0.073	E7	Party floor between dwellings (in blocks of flats)
	3.39	0	P3	Intermediate floor between dwellings (in blocks of flats)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Heat pumps with radiators or underfloor heating Electric heat pumps Fuel: Electricity Info Source: Boiler Database Database: (rev 512, product index 101403, SEDBUK 250%): Brand name: Vaillant Model: aroTHERM Model qualifier: VWL 85/2 - Underfloor (provides DHW all year) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Unknown Boiler interlock: Yes

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2207

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :Electricity Hot water cylinder Cylinder volume: 90 litres Cylinder insulation: Measured loss, 0.85kWh/day Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Flue Gas Heat Recovery System: Database (rev 512, product index) Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory

SAP Input

Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: FF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.21	(1a) x	2.5	(2a) =	183.02	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.21	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	183.02	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30 ÷ (5) =	0.16	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)		0.41	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

SAP WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			13.33	x1/[1/(1.3)+ 0.04]		=	16.47			(27)
Windows Type 2			5.64	x1/[1/(1.3)+ 0.04]		=	6.97			(27)
Walls Type1	71.92	18.97	52.95	x	0.24	=	12.71			(29)
Walls Type2	13.03	1.89	11.14	x	0.11	=	1.17			(29)
Total area of elements, m²			84.95							(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) = 40.34 (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 4.61 (36)

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

Total fabric heat loss (33) + (36) = 44.95 (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=	36.28	36.04	35.81	34.72	34.52	33.57	33.57	33.4	33.94	34.52	34.93	35.36	(38)

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

(39)m=	81.23	80.99	80.76	79.68	79.47	78.53	78.53	78.35	78.89	79.47	79.88	80.31	

Average = Sum(39)$_{1…12}$ /12= 79.68 (39)

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

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.32 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.33 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.27	94.69	91.12	87.55	83.97	80.4	80.4	83.97	87.55	91.12	94.69	98.27	
										Total = Sum(44)$_{1…12}$ =		1072.02	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	145.73	127.46	131.52	114.66	110.02	94.94	87.98	100.96	102.16	119.06	129.96	141.13	
										Total = Sum(45)$_{1…12}$ =		1405.59	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.86	19.12	19.73	17.2	16.5	14.24	13.2	15.14	15.32	17.86	19.49	21.17	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62	

Output from water heater (annual)$_{1...12}$ 1847.02 (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=	78.45	69.47	73.72	67.15	66.58	60.59	59.25	63.56	62.99	69.58	72.24	76.92	(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=	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	139.29	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	45.62	40.52	32.95	24.95	18.65	15.74	17.01	22.11	29.68	37.68	43.98	46.88	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	305.48	308.65	300.66	283.65	262.19	242.01	228.53	225.36	233.35	250.36	271.82	292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	51.25	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	(71)
Water heating gains (Table 5)													
(72)m=	105.44	103.38	99.09	93.27	89.48	84.16	79.63	85.43	87.49	93.52	100.33	103.39	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	554.21	550.22	530.38	499.54	468	439.59	422.85	430.58	448.2	479.24	513.81	539.95	(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)	
Southeast 0.9x	0.77	x	13.33	x	36.79	x	0.63	x	0.7	=	149.89	(77)
Southeast 0.9x	0.77	x	13.33	x	62.67	x	0.63	x	0.7	=	255.32	(77)
Southeast 0.9x	0.77	x	13.33	x	85.75	x	0.63	x	0.7	=	349.34	(77)
Southeast 0.9x	0.77	x	13.33	x	106.25	x	0.63	x	0.7	=	432.85	(77)

Southeast	0.9x	0.77	x	13.33	x	119.01	x	0.63	x	0.7	=	484.83	(77)
Southeast	0.9x	0.77	x	13.33	x	118.15	x	0.63	x	0.7	=	481.32	(77)
Southeast	0.9x	0.77	x	13.33	x	113.91	x	0.63	x	0.7	=	464.05	(77)
Southeast	0.9x	0.77	x	13.33	x	104.39	x	0.63	x	0.7	=	425.27	(77)
Southeast	0.9x	0.77	x	13.33	x	92.85	x	0.63	x	0.7	=	378.26	(77)
Southeast	0.9x	0.77	x	13.33	x	69.27	x	0.63	x	0.7	=	282.18	(77)
Southeast	0.9x	0.77	x	13.33	x	44.07	x	0.63	x	0.7	=	179.54	(77)
Southeast	0.9x	0.77	x	13.33	x	31.49	x	0.63	x	0.7	=	128.28	(77)
Northwest	0.9x	0.77	x	5.64	x	11.28	x	0.63	x	0.7	=	19.45	(81)
Northwest	0.9x	0.77	x	5.64	x	22.97	x	0.63	x	0.7	=	39.59	(81)
Northwest	0.9x	0.77	x	5.64	x	41.38	x	0.63	x	0.7	=	71.32	(81)
Northwest	0.9x	0.77	x	5.64	x	67.96	x	0.63	x	0.7	=	117.13	(81)
Northwest	0.9x	0.77	x	5.64	x	91.35	x	0.63	x	0.7	=	157.45	(81)
Northwest	0.9x	0.77	x	5.64	x	97.38	x	0.63	x	0.7	=	167.86	(81)
Northwest	0.9x	0.77	x	5.64	x	91.1	x	0.63	x	0.7	=	157.03	(81)
Northwest	0.9x	0.77	x	5.64	x	72.63	x	0.63	x	0.7	=	125.18	(81)
Northwest	0.9x	0.77	x	5.64	x	50.42	x	0.63	x	0.7	=	86.91	(81)
Northwest	0.9x	0.77	x	5.64	x	28.07	x	0.63	x	0.7	=	48.38	(81)
Northwest	0.9x	0.77	x	5.64	x	14.2	x	0.63	x	0.7	=	24.47	(81)
Northwest	0.9x	0.77	x	5.64	x	9.21	x	0.63	x	0.7	=	15.88	(81)

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

(83)m=	169.34	294.91	420.66	549.98	642.28	649.18	621.07	550.45	465.17	330.56	204.01	144.16	(83)

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

(84)m=	723.55	845.13	951.04	1049.53	1110.27	1088.77	1043.93	981.04	913.37	809.8	717.82	684.11	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.96	0.91	0.8	0.64	0.46	0.33	0.37	0.58	0.85	0.96	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

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

(89)m=	0.98	0.95	0.89	0.76	0.58	0.39	0.26	0.29	0.5	0.81	0.95	0.98	(89)

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

(90)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(90)

fLA = Living area ÷ (4) = | 0.41 | (91)

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

(92)m=	20.41	20.41	20.41	20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.41	20.41	(92)

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

(93)m=	20.41	20.41	20.41	20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.41	20.41	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.95	0.9	0.78	0.6	0.42	0.29	0.32	0.54	0.82	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	708.04	806.34	855.63	817.36	669.83	454.64	299.95	314.82	489.28	667.54	685.33	672.61	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1308.25	1255.98	1123.3	917.53	692.78	457.29	300.24	315.33	498.67	780.2	1063.61	1302.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	446.55	302.16	199.14	72.12	17.07	0	0	0	0	83.82	272.36	468.28	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1861.5	(98)
Space heating requirement in kWh/m²/year	25.43	(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		249.86	(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)														
	446.55	302.16	199.14	72.12	17.07	0	0	0	0	83.82	272.36	468.28		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	178.72	120.93	79.7	28.87	6.83	0	0	0	0	33.55	109.01	187.42		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													745.03	(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)														
	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	157.73	138.88	145.5	129.95	126.99	112.97	108.01	119.19	119.18	134.77	143.12	153.77		
Total = Sum(219a)$_{1...12}$ =													1590.06	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		745.03

SAP WorkSheet: New dwelling design stage

Water heating fuel used			1590.06	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			322.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2657.33	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	13.19	x 0.01 =	98.27	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	209.73	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	0	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	42.5	(250)
Additional standing charges (Table 12)				0	(251)

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

Total energy cost	(245)...(247) + (250)…(254) =	350.5	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.25	(257)
SAP rating (Section 12)		82.63	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.519	=	386.67	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	825.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1211.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	167.24	(268)
Total CO2, kg/year		sum of (265)…(271) =		1379.15	(272)
CO2 emissions per m²		(272) ÷ (4) =		18.84	(273)
EI rating (section 14)				84	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	3.07	=	2287.23	(261)

Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	3.07	=	4881.49	(264)
Space and water heating	(261) + (262) + (263) + (264) =			7168.72	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0	(267)
Electricity for lighting	(232) x	0	=	989.27	(268)
‘Total Primary Energy	sum of (265)…(271) =			8157.99	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			111.43	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: FF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.21	(1a) x	2.5	(2a) =	183.02	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.21	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	183.02	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) = 0.16	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

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

DER WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			13.33	x1/[1/(1.3)+ 0.04]		=	16.47			(27)
Windows Type 2			5.64	x1/[1/(1.3)+ 0.04]		=	6.97			(27)
Walls Type1	71.92	18.97	52.95	x	0.24	=	12.71			(29)
Walls Type2	13.03	1.89	11.14	x	0.11	=	1.17			(29)
Total area of elements, m²			84.95							(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) = 40.34 (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 4.61 (36)

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

Total fabric heat loss (33) + (36) = 44.95 (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=	36.28	36.04	35.81	34.72	34.52	33.57	33.57	33.4	33.94	34.52	34.93	35.36	(38)

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

(39)m=	81.23	80.99	80.76	79.68	79.47	78.53	78.53	78.35	78.89	79.47	79.88	80.31	

Average = Sum(39)$_{1…12}$ /12= 79.68 (39)

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

(40)m=	1.11	1.11	1.1	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.09	1.1

Average = Sum(40)$_{1…12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.32 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 89.33 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	98.27	94.69	91.12	87.55	83.97	80.4	80.4	83.97	87.55	91.12	94.69	98.27	
									Total = Sum(44)$_{1…12}$ =			1072.02	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	145.73	127.46	131.52	114.66	110.02	94.94	87.98	100.96	102.16	119.06	129.96	141.13	
									Total = Sum(45)$_{1…12}$ =			1405.59	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.86	19.12	19.73	17.2	16.5	14.24	13.2	15.14	15.32	17.86	19.49	21.17	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62	

Output from water heater (annual)$_{1…12}$ 1847.02 (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=	78.45	69.47	73.72	67.15	66.58	60.59	59.25	63.56	62.99	69.58	72.24	76.92	(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=	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	116.07	(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	8.84	11.87	15.07	17.59	18.75	(67)

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

(68)m=	204.67	206.79	201.44	190.05	175.67	162.15	153.12	150.99	156.35	167.74	182.12	195.64	(68)

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

(69)m=	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	34.61	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	-92.86	(71)

Water heating gains (Table 5)

(72)m=	105.44	103.38	99.09	93.27	89.48	84.16	79.63	85.43	87.49	93.52	100.33	103.39	(72)

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

(73)m=	386.18	384.2	371.54	351.11	330.43	310.43	297.37	303.09	313.53	334.16	357.87	375.6	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	13.33	x	36.79	x	0.63	x	0.7	=	149.89	(77)
Southeast 0.9x	0.77	x	13.33	x	62.67	x	0.63	x	0.7	=	255.32	(77)
Southeast 0.9x	0.77	x	13.33	x	85.75	x	0.63	x	0.7	=	349.34	(77)
Southeast 0.9x	0.77	x	13.33	x	106.25	x	0.63	x	0.7	=	432.85	(77)

Southeast	0.9x	0.77	x	13.33	x	119.01	x	0.63	x	0.7	=	484.83	(77)
Southeast	0.9x	0.77	x	13.33	x	118.15	x	0.63	x	0.7	=	481.32	(77)
Southeast	0.9x	0.77	x	13.33	x	113.91	x	0.63	x	0.7	=	464.05	(77)
Southeast	0.9x	0.77	x	13.33	x	104.39	x	0.63	x	0.7	=	425.27	(77)
Southeast	0.9x	0.77	x	13.33	x	92.85	x	0.63	x	0.7	=	378.26	(77)
Southeast	0.9x	0.77	x	13.33	x	69.27	x	0.63	x	0.7	=	282.18	(77)
Southeast	0.9x	0.77	x	13.33	x	44.07	x	0.63	x	0.7	=	179.54	(77)
Southeast	0.9x	0.77	x	13.33	x	31.49	x	0.63	x	0.7	=	128.28	(77)
Northwest	0.9x	0.77	x	5.64	x	11.28	x	0.63	x	0.7	=	19.45	(81)
Northwest	0.9x	0.77	x	5.64	x	22.97	x	0.63	x	0.7	=	39.59	(81)
Northwest	0.9x	0.77	x	5.64	x	41.38	x	0.63	x	0.7	=	71.32	(81)
Northwest	0.9x	0.77	x	5.64	x	67.96	x	0.63	x	0.7	=	117.13	(81)
Northwest	0.9x	0.77	x	5.64	x	91.35	x	0.63	x	0.7	=	157.45	(81)
Northwest	0.9x	0.77	x	5.64	x	97.38	x	0.63	x	0.7	=	167.86	(81)
Northwest	0.9x	0.77	x	5.64	x	91.1	x	0.63	x	0.7	=	157.03	(81)
Northwest	0.9x	0.77	x	5.64	x	72.63	x	0.63	x	0.7	=	125.18	(81)
Northwest	0.9x	0.77	x	5.64	x	50.42	x	0.63	x	0.7	=	86.91	(81)
Northwest	0.9x	0.77	x	5.64	x	28.07	x	0.63	x	0.7	=	48.38	(81)
Northwest	0.9x	0.77	x	5.64	x	14.2	x	0.63	x	0.7	=	24.47	(81)
Northwest	0.9x	0.77	x	5.64	x	9.21	x	0.63	x	0.7	=	15.88	(81)

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

(83)m=	169.34	294.91	420.66	549.98	642.28	649.18	621.07	550.45	465.17	330.56	204.01	144.16	(83)

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

(84)m=	555.52	679.11	792.2	901.1	972.71	959.6	918.45	853.54	778.7	664.72	561.87	519.76	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.71	0.52	0.37	0.42	0.66	0.92	0.99	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(88)

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

(89)m=	0.99	0.98	0.94	0.83	0.65	0.44	0.29	0.33	0.58	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=	19.99	20	20	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20.01	20	(90)

fLA = Living area ÷ (4) = 0.41 (91)

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

(92)m=	20.41	20.41	20.41	20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.41	20.41	(92)

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

DER WorkSheet: New dwelling design stage

(93)m=	20.41	20.41	20.41	20.42	20.42	20.42	20.42	20.42	20.42	20.42	20.41	20.41	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.99	0.98	0.95	0.85	0.67	0.47	0.33	0.37	0.62	0.9	0.98	1		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	551.69	665.95	749.23	763.76	654.86	452.59	299.71	314.34	480.66	597.88	552.36	517.16		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1308.25	1255.98	1123.3	917.53	692.78	457.29	300.24	315.33	498.67	780.2	1063.61	1302.02		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	562.88	396.5	278.31	110.71	28.21	0	0	0	0	135.64	368.1	583.93		
Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =													2464.29	(98)
Space heating requirement in kWh/m²/year													33.66	(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		249.86	(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)														
	562.88	396.5	278.31	110.71	28.21	0	0	0	0	135.64	368.1	583.93		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	225.28	158.69	111.39	44.31	11.29	0	0	0	0	54.29	147.33	233.71		
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													986.28	(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)														
	183.22	161.32	169.01	150.95	147.51	131.22	125.47	138.45	138.44	156.55	166.24	178.62		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	157.73	138.88	145.5	129.95	126.99	112.97	108.01	119.19	119.18	134.77	143.12	153.77		
Total = Sum(219a)$_{1...12}$ =													1590.06	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		986.28

DER WorkSheet: New dwelling design stage

Water heating fuel used		1590.06	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	0	(231)
Electricity for lighting		322.24	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2898.58	(338)

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	0.519	=	511.88	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	825.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1337.12	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	167.24	(268)
Total CO2, kg/year			sum of (265)…(271) =		1504.36	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		20.55	(273)
EI rating (section 14)					83	(274)

SAP Input

Property Details: SF Flat

Address:	
Located in:	England
Region:	Thames valley
UPRN:	
Date of assessment:	05 October 2023
Date of certificate:	05 October 2023
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	512

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2023	
Floor Location:	Floor area:	
		Storey height:
Floor 0	59.71 m²	2.5 m
Living area:	20.52 m² (fraction 0.344)	
Front of dwelling faces:	South East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
se	Manufacturer	Solid			
nw	Manufacturer	Windows	low-E, En = 0.05, soft coat	Yes	

Name:	Gap:	Frame Factor:	g-value:	U-value:	Area:	No. of Openings:
se	mm	0.7	0.63	1.6	1.89	1
nw	16mm or more	0.7	0.63	1.3	12.93	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
se		Shel	South East	0	0
nw		Ext.	North West	0	0

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
External Elements							
Ext.	29.43	12.93	16.5	0.24	0	False	N/A
Shel	25.2	1.89	23.31	0.11	0.43	False	N/A
Flat Roof	59.71	0	59.71	0.12	0		N/A
Internal Elements							
Party Elements							

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0696

Length	Psi-value		
6.71	0.05	E2	Other lintels (including other steel lintels)
21.94	0.04	E4	Jamb
7.5	0.058	E16	Corner (normal)

SAP Input

	5	-0.069	E17	Corner (inverted internal area greater than external area)
	7.5	0.068	E18	Party wall between dwellings
	21.85	0.073	E7	Party floor between dwellings (in blocks of flats)
	21.85	0.08	E14	Flat roof
	11.69	0	P3	Intermediate floor between dwellings (in blocks of flats)
	11.69	0.24	P4	Roof (insulation at ceiling level)

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Natural ventilation (extract fans)
Number of chimneys:	0
Number of open flues:	0
Number of fans:	3
Number of passive stacks:	0
Number of sides sheltered:	2
Pressure test:	5

Main heating system:

Main heating system:	Heat pumps with radiators or underfloor heating Electric heat pumps Fuel: Electricity Info Source: Boiler Database Database: (rev 512, product index 101403, SEDBUK 221%): Brand name: Vaillant Model: aroTHERM Model qualifier: VWL 85/2 - Underfloor (provides DHW all year) Systems with radiators Central heating pump : 2013 or later Design flow temperature: Design flow temperature >45°C Unknown Boiler interlock: Yes

Main heating Control:

Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2207

Secondary heating system:

Secondary heating system:	None

Water heating:

Water heating:	From main heating system Water code: 901 Fuel :Electricity Hot water cylinder Cylinder volume: 90 litres Cylinder insulation: Measured loss, 0.85kWh/day Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Flue Gas Heat Recovery System: Database (rev 512, product index) Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%

SAP Input

Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	None
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: SF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.71	(1a) x	2.5	(2a) =	149.27	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.71	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.27	(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) =	0.2	(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)	0.45	(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) =	0.38	(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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows			12.93	x1/[1/(1.3)+ 0.04]		=	15.98			(27)
Walls Type1	29.43	12.93	16.5	x	0.24	=	3.96			(29)
Walls Type2	25.2	1.89	23.31	x	0.11	=	2.45			(29)
Roof	59.71	0	59.71	x	0.12	=	7.17			(30)
Total area of elements, m²			114.34							(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) = 32.58 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 537.39 (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 7.96 (36)

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

Total fabric heat loss (33) + (36) = 40.54 (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=	30.51	30.29	30.06	29.01	28.81	27.9	27.9	27.73	28.25	28.81	29.21	29.63	(38)

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

(39)m=	71.05	70.82	70.6	69.55	69.35	68.43	68.43	68.26	68.79	69.35	69.75	70.16	

Average = Sum(39)$_{1…12}$ /12= 69.55 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.19	1.19	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.17	1.18

Average = Sum(40)$_{1…12}$ /12= 1.16 (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 1.97 (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 81.07 (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=	89.18	85.93	82.69	79.45	76.2	72.96	72.96	76.2	79.45	82.69	85.93	89.18

Total = Sum(44)$_{1…12}$ = 972.83 (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=	132.24	115.66	119.35	104.05	99.84	86.16	79.84	91.61	92.71	108.04	117.94	128.07

Total = Sum(45)$_{1…12}$ = 1275.53 (45)

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

(46)m=	19.84	17.35	17.9	15.61	14.98	12.92	11.98	13.74	13.91	16.21	17.69	19.21

(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23

(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23

(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=	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56	

Output from water heater (annual)1…12 | 1716.96 | (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=	73.96	65.55	69.68	63.62	63.19	57.67	56.54	60.45	59.85	65.92	68.24	72.58	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	118.41	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	38.42	34.12	27.75	21.01	15.7	13.26	14.33	18.62	24.99	31.74	37.04	39.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	257.04	259.7	252.98	238.67	220.61	203.64	192.29	189.63	196.35	210.66	228.72	245.7	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	48.81	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	(71)
Water heating gains (Table 5)													
(72)m=	99.41	97.54	93.65	88.37	84.93	80.1	75.99	81.26	83.13	88.6	94.78	97.55	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	483.15	479.65	462.67	436.33	409.53	385.28	370.9	377.79	392.75	419.27	448.82	471.02	(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)	
Northwest	0.9x	0.77	x	12.93	x	11.28	x	0.63	x	0.7	=	44.59	(81)
Northwest	0.9x	0.77	x	12.93	x	22.97	x	0.63	x	0.7	=	90.75	(81)
Northwest	0.9x	0.77	x	12.93	x	41.38	x	0.63	x	0.7	=	163.51	(81)
Northwest	0.9x	0.77	x	12.93	x	67.96	x	0.63	x	0.7	=	268.53	(81)

Northwest	0.9x	0.77	x	12.93	x	91.35	x	0.63	x	0.7	=	360.96	(81)
Northwest	0.9x	0.77	x	12.93	x	97.38	x	0.63	x	0.7	=	384.82	(81)
Northwest	0.9x	0.77	x	12.93	x	91.1	x	0.63	x	0.7	=	359.99	(81)
Northwest	0.9x	0.77	x	12.93	x	72.63	x	0.63	x	0.7	=	286.99	(81)
Northwest	0.9x	0.77	x	12.93	x	50.42	x	0.63	x	0.7	=	199.24	(81)
Northwest	0.9x	0.77	x	12.93	x	28.07	x	0.63	x	0.7	=	110.91	(81)
Northwest	0.9x	0.77	x	12.93	x	14.2	x	0.63	x	0.7	=	56.1	(81)
Northwest	0.9x	0.77	x	12.93	x	9.21	x	0.63	x	0.7	=	36.41	(81)

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

(83)m=	44.59	90.75	163.51	268.53	360.96	384.82	359.99	286.99	199.24	110.91	56.1	36.41	(83)

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

(84)m=	527.74	570.41	626.18	704.87	770.49	770.1	730.89	664.78	591.99	530.18	504.92	507.43	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.75	0.55	0.41	0.47	0.73	0.93	0.98	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	0.99	0.98	0.95	0.87	0.69	0.47	0.31	0.36	0.65	0.9	0.97	0.99	(89)

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

(90)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	20.3	20.3	20.3	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.3	(92)

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

(93)m=	20.3	20.3	20.3	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.3	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.88	0.71	0.5	0.35	0.4	0.68	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	521.03	558.82	598.7	618.76	549.01	384.95	253.73	266.05	400.59	485.23	493.05	502.02	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1136.57	1090.56	974.29	793.51	597.21	391.42	254.55	267.67	427.61	673.49	921.23	1129.95	(97)

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

(98)m=	457.96	357.33	279.44	125.82	35.86	0	0	0	0	140.07	308.29	467.18

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2171.94 (98)

Space heating requirement in kWh/m²/year 36.37 (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		221.06	(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)	457.96	357.33	279.44	125.82	35.86	0	0	0	0	140.07	308.29	467.18		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	207.16	161.64	126.41	56.92	16.22	0	0	0	0	63.36	139.46	211.33		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													982.51	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	146.12	128.72	135.02	120.81	118.23	105.41	101.01	111.14	111.05	125.29	132.76	142.53		
Total = Sum(219a)$_{1...12}$ =													1478.1	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			982.51	
Water heating fuel used			1478.1	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			271.4	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2732.01	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)	**Fuel Cost** £/year

SAP WorkSheet: New dwelling design stage

Space heating - main system 1	(211) x	13.19	x 0.01 =	129.59 (240)
Space heating - main system 2	(213) x	0	x 0.01 =	0 (241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0 (242)
Water heating cost (other fuel)	(219)	13.19	x 0.01 =	194.96 (247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	0 (249)

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

Energy for lighting	(232)	13.19	x 0.01 =	35.8 (250)
Additional standing charges (Table 12)				0 (251)

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

Total energy cost (245)...(247) + (250)...(254) = 360.35 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42 (256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.45 (257)
SAP rating (Section 12)		79.84 (258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year
Space heating (main system 1)	(211) x	0.519	=	509.92 (261)
Space heating (secondary)	(215) x	0.519	=	0 (263)
Water heating	(219) x	0.519	=	767.13 (264)
Space and water heating	(261) + (262) + (263) + (264) =			1277.06 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0 (267)
Electricity for lighting	(232) x	0.519	=	140.86 (268)
Total CO2, kg/year		sum of (265)…(271) =		1417.91 (272)
CO2 emissions per m²		(272) ÷ (4) =		23.75 (273)
EI rating (section 14)				82 (274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year
Space heating (main system 1)	(211) x	3.07	=	3016.31 (261)
Space heating (secondary)	(215) x	3.07	=	0 (263)
Energy for water heating	(219) x	3.07	=	4537.76 (264)
Space and water heating	(261) + (262) + (263) + (264) =			7554.07 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	0 (267)
Electricity for lighting	(232) x	0	=	833.2 (268)
'Total Primary Energy		sum of (265)…(271) =		8387.27 (272)

Primary energy kWh/m²/year	(272) ÷ (4) =	140.47	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Bethany Robinson	**Stroma Number:**	STRO036516
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.60

Property Address: SF Flat

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	59.71	(1a) x	2.5	(2a) =	149.27	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	59.71	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.27	(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) =	0.2	(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)	0.45	(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) =	0.38	(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

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45

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=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(24d)

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

(25)m=	0.62	0.61	0.61	0.59	0.58	0.57	0.57	0.56	0.57	0.58	0.59	0.6	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows			12.93	x1/[1/(1.3)+ 0.04]		=	15.98			(27)
Walls Type1	29.43	12.93	16.5	x	0.24	=	3.96			(29)
Walls Type2	25.2	1.89	23.31	x	0.11	=	2.45			(29)
Roof	59.71	0	59.71	x	0.12	=	7.17			(30)
Total area of elements, m²			114.34							(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) =	32.58	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	537.39	(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		7.96	(36)

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

Total fabric heat loss	(33) + (36) =	40.54	(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=	30.51	30.29	30.06	29.01	28.81	27.9	27.9	27.73	28.25	28.81	29.21	29.63	(38)

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

(39)m=	71.05	70.82	70.6	69.55	69.35	68.43	68.43	68.26	68.79	69.35	69.75	70.16	

Average = $Sum(39)_{1…12}$ /12= 69.55 (39)

DER WorkSheet: New dwelling design stage

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

(40)m=	1.19	1.19	1.18	1.16	1.16	1.15	1.15	1.14	1.15	1.16	1.17	1.18

Average = Sum(40)$_{1…12}$ /12= 1.16 (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 1.97 (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 81.07 (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=	89.18	85.93	82.69	79.45	76.2	72.96	72.96	76.2	79.45	82.69	85.93	89.18

Total = Sum(44)$_{1…12}$ = 972.83 (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=	132.24	115.66	119.35	104.05	99.84	86.16	79.84	91.61	92.71	108.04	117.94	128.07

Total = Sum(45)$_{1…12}$ = 1275.53 (45)

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

(46)m=	19.84	17.35	17.9	15.61	14.98	12.92	11.98	13.74	13.91	16.21	17.69	19.21	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 90 (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): 0.85 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.46 (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) 0.46 (55)

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

(56)m=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	14.23	12.85	14.23	13.77	14.23	13.77	14.23	14.23	13.77	14.23	13.77	14.23	(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=	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56	

Output from water heater (annual)1…12 | 1716.96 | (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=	73.96	65.55	69.68	63.62	63.19	57.67	56.54	60.45	59.85	65.92	68.24	72.58	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	98.67	(66)

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

(67)m=	15.37	13.65	11.1	8.4	6.28	5.3	5.73	7.45	10	12.69	14.82	15.79	(67)

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

(68)m=	172.21	174	169.5	159.91	147.81	136.44	128.84	127.05	131.55	141.14	153.24	164.62	(68)

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

(69)m=	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	32.87	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	-78.94	(71)

Water heating gains (Table 5)

(72)m=	99.41	97.54	93.65	88.37	84.93	80.1	75.99	81.26	83.13	88.6	94.78	97.55	(72)

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

(73)m=	339.6	337.79	326.85	309.28	291.63	274.44	263.16	268.36	277.28	295.03	315.44	330.56	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northwest	0.9x	0.77	x	12.93	x	11.28	x	0.63	x	0.7	=	44.59	(81)
Northwest	0.9x	0.77	x	12.93	x	22.97	x	0.63	x	0.7	=	90.75	(81)
Northwest	0.9x	0.77	x	12.93	x	41.38	x	0.63	x	0.7	=	163.51	(81)
Northwest	0.9x	0.77	x	12.93	x	67.96	x	0.63	x	0.7	=	268.53	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	12.93	x	91.35	x	0.63	x	0.7	=	360.96	(81)
Northwest	0.9x	0.77	x	12.93	x	97.38	x	0.63	x	0.7	=	384.82	(81)
Northwest	0.9x	0.77	x	12.93	x	91.1	x	0.63	x	0.7	=	359.99	(81)
Northwest	0.9x	0.77	x	12.93	x	72.63	x	0.63	x	0.7	=	286.99	(81)
Northwest	0.9x	0.77	x	12.93	x	50.42	x	0.63	x	0.7	=	199.24	(81)
Northwest	0.9x	0.77	x	12.93	x	28.07	x	0.63	x	0.7	=	110.91	(81)
Northwest	0.9x	0.77	x	12.93	x	14.2	x	0.63	x	0.7	=	56.1	(81)
Northwest	0.9x	0.77	x	12.93	x	9.21	x	0.63	x	0.7	=	36.41	(81)

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

(83)m=	44.59	90.75	163.51	268.53	360.96	384.82	359.99	286.99	199.24	110.91	56.1	36.41	(83)

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

(84)m=	384.18	428.55	490.37	577.82	652.59	659.26	623.16	555.35	476.52	405.94	371.54	366.97	(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	0.83	0.63	0.48	0.55	0.83	0.97	0.99	1	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(88)

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

(89)m=	1	0.99	0.98	0.93	0.77	0.54	0.37	0.43	0.76	0.96	0.99	1	(89)

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

(90)m=	19.93	19.93	19.93	19.95	19.95	19.96	19.96	19.97	19.96	19.95	19.95	19.94	(90)

fLA = Living area ÷ (4) = 0.34 (91)

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

(92)m=	20.3	20.3	20.3	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.3	(92)

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

(93)m=	20.3	20.3	20.3	20.31	20.31	20.32	20.32	20.32	20.32	20.31	20.31	20.3	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.79	0.58	0.41	0.48	0.79	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	382.92	425.87	481.88	539.67	518.14	379.41	252.89	264.15	374.39	392.37	369.08	366.01	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1136.57	1090.56	974.29	793.51	597.21	391.42	254.55	267.67	427.61	673.49	921.23	1129.95	(97)

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

(98)m=	560.71	446.67	366.35	182.77	58.83	0	0	0	0	209.16	397.55	568.37

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2790.4 (98)

Space heating requirement in kWh/m²/year 46.73 (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		221.06	(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)	560.71	446.67	366.35	182.77	58.83	0	0	0	0	209.16	397.55	568.37		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	253.65	202.06	165.73	82.68	26.61	0	0	0	0	94.61	179.84	257.11		(211)
Total (kWh/year) =$Sum(211)_{1...5,10....12}$=													1262.28	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =$Sum(215)_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)	169.74	149.53	156.84	140.34	137.33	122.44	117.33	129.11	128.99	145.53	154.22	165.56		
Efficiency of water heater													116.16	(216)
(217)m=	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16	116.16		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	146.12	128.72	135.02	120.81	118.23	105.41	101.01	111.14	111.05	125.29	132.76	142.53		
Total = $Sum(219a)_{1...12}$ =													1478.1	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1262.28	
Water heating fuel used			1478.1	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)
Electricity for lighting			271.4	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			3011.78	(338)

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

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

DER WorkSheet: New dwelling design stage

Space heating (main system 1)	(211) x	0.519	=	655.12	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	767.13	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1422.26	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	140.86	(268)
Total CO2, kg/year		sum of (265)…(271) =		1563.11	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		26.18	(273)
EI rating (section 14)				80	(274)