Sustainability & Energy Statement

Land adjacent Axis House, Bath Road, Harlington. UB3 5AY

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Executive Summary

This Sustainability and Energy Statement has been prepared in support of a planning application for the construction of a 7-storey building, comprising 60, 1, 2 and 3-bedroom apartments on land adjacent Axis House, Bath Road, Harlington.

The Statement sets out the commitments of the applicant to the site and the targets that will be applied to the development.

The methodology used has been based upon the 'Energy Assessment Guidance' published by the Mayor of London in June 2022 and uses the carbon factors for gas and electricity proposed for SAP 10.2.

In order to demonstrate the energy efficiency of the building a set of SAP calculations have been prepared for representative apartments for the 'Be Lean' scenario based on the notional systems specification set out in the Part L 2021 baseline. This includes the installation of a gas boiler, WWHRs and a photovoltaic array which is based on an output in kWp of 40% of the ground-floor area/ (6.5 x number of stories in the block). This is not the proposed strategy but purely demonstrates the reduction from the 'Be Lean' condition.

The TER & DER Worksheets for the modelled units and the Be Lean case are attached as Appendix 1.

The fabric standards of the apartments will exceed the requirements of the Building Regulations.

It is proposed to install heat pumps into each apartment, all connected to a medium temperature loop within the building. In addition, the Roof Plan attached as Appendix 3 demonstrates a total of 162 photovoltaic panels can be installed without detrimentally impacting on the aesthetics of the development (the output of the panels is assumed to be 400W).

A further set of SAP calculations have been prepared based on the proposed specification and the DER Worksheets for the Be Green scenario are attached as Appendix 2.

The completed GLA Carbon Emissions Reporting Spreadsheet accompanies the planning application but the reductions in emissions can be summarised as follows:

	Total Emissions	% Reduction
	kg CO_2 per year	
Be Lean		
Baseline (Building Regulations TER) – based on gas	45,336	
Be Lean - after energy efficiency (DER) – based on gas	44,044	**2.85%**
Be Green (ASHP & Photovoltaic Panels)		
Be Green Emissions	1,159	**97.44%**

It should be noted that the reductions are impacted by the requirement for the windows to the development to be modelled as closed in order to meet the requirements of the Noise Assessment.

Having to model the apartments with closed windows means that in order to pass the Overheating Assessment the 'g' value for the glazing needs to be low, which in turn reduces winter solar gain and hence the Be Lean energy efficiency of the building.

The residual emissions are 1.159 tonnes and therefore the carbon offset payment will be **£3,303** (1.159 x £2,850).

1.0 Introduction

This report has been commissioned by Westcombe Group and provides a Sustainability and Energy Statement in support of a planning application for the development of land adjacent to Axis House, Bath Road, Harlington to provide a 7-storey building comprising 60, 1, 2 & 3-bedroom apartments.

The report describes the methodology used in assessing the development and the initiatives proposed.

The building has been designed and will be constructed to reduce energy demand and carbon dioxide emissions.

The objective is to reduce the energy demand to an economic minimum by making investments in the parts of the building that has the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric.

Once a cost-effective structure has been designed, low-carbon and renewable technologies have been considered to provide heat and/or electricity.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2023

Paragraph 152 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Regional and Local Policies

The Development Plan comprises the London Plan (2021) and the London Borough of Hillingdon Local Plan Part 1 (2012) and Part 2 (2020).

The policies have been edited for relevance to this application.

London Plan, published March 2021 **–** the following policies are relevant to the application:

Policy SI 1 Improving air quality

A *Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.*

B *To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:*

1) Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:

a) development proposals must be at least Air Quality Neutral

b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C *Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:*

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D *In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.*

E *Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.*

Policy SI 2 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:*
   1) *through a cash in lieu contribution to the borough's carbon offset fund, or*
   2) *off-site provided that an alternative proposal is identified and delivery is certain.*

D *Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.*

E *Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*

F *Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

Policy SI 4 Managing heat risk

A *Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*

B *Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:*

1) *reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure*
2) *minimise internal heat generation through energy efficient design*
3) *manage the heat within the building through exposed internal thermal mass and high ceilings*
4) *provide passive ventilation*
5) *provide mechanical ventilation*
6) *provide active cooling systems.*

Policy SI 5 Water infrastructure

A *In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.*

B *Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.*

C *Development proposals should:*

1) *through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
2) *achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)*
3) *incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*

D *In terms of water quality, Development Plans should:*

1) *promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans*
2) *support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.*

E *Development proposals should:*

1) *seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided*

2) *take action to minimise the potential for misconnections between foul and surface water networks. F Development Plans and proposals for strategically or locally defined growth locations with particular flood risk constraints or where there is insufficient water infrastructure capacity should be informed by Integrated Water Management Strategies at an early stage.*

Hillingdon Local Plan: Part 1 Strategic Policies, adopted November 2012

The following policies have been edited for relevance to this application;

Policy BE1: Built Environment

The Council will require all new development to improve and maintain the quality of the built environment in order to create successful and sustainable neighbourhoods, where people enjoy living and working and that serve the long-term needs of all residents. All new development should:

1. *Achieve a high quality of design in all new buildings, alterations, extensions and the public realm which enhances the local distinctiveness of the area, contributes to community cohesion and a sense of place;*
2. *Be designed to be appropriate to the identity and context of Hillingdon's buildings, townscapes, landscapes and views, and make a positive contribution to the local area in terms of layout, form, scale and materials and seek to protect the amenity of surrounding land and buildings, particularly residential properties;*
3. *Be designed to include "Lifetime Homes" principles so that they can be readily adapted to meet the needs of those with disabilities and the elderly, 10% of these should be wheelchair accessible or easily adaptable to wheelchair accessibility encouraging places of work and leisure, streets, neighbourhoods, parks and open spaces to be designed to meet the needs of the community at all stages of people's lives;*
4. *In the case of 10 dwellings or over, achieve a satisfactory assessment rating in terms of the latest Building for Life standards (as amended or replaced from time to time);*
5. *Improve areas of poorer environmental quality, including within the areas of relative disadvantage of Hayes, Yiewsley and West Drayton. All regeneration schemes should ensure that they are appropriate to their historic context, make use of heritage assets and reinforce their significance;*
6. *Incorporate a clear network of routes that are easy to understand, inclusive, safe, secure and connect positively with interchanges, public transport, community facilities and services;*
7. *Improve the quality of the public realm and provide for public and private spaces that are attractive, safe, functional, diverse, sustainable, accessible to all, respect the local character and landscape, integrate with the development, enhance and protect biodiversity through the inclusion of living walls, roofs and areas for wildlife, encourage physical activity and where appropriate introduce public art;*
8. *Create safe and secure environments that reduce crime and fear of crime, anti-social behaviour and risks from fire and arson having regard to Secure by Design standards and address resilience to terrorism in major development proposals;*

9. *Not result in the inappropriate development of gardens and green spaces that erode the character and biodiversity of suburban areas and increase the risk of flooding through the loss of permeable areas;*
10. *Maximise the opportunities for all new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants. The Council will require all new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies. Where the required reduction from on-site renewable energy is not feasible within major developments, contributions off-site will be sought. The Council will seek to merge a suite of sustainable design goals, such as the use of SUDS, water efficiency, lifetime homes, and energy efficiency into a requirement measured against the Code for Sustainable Homes and BREEAM. These will be set out within the Hillingdon Local Plan: Part 2- Development Management Policies Local Development Document (LDD). All developments should be designed to make the most efficient use of natural resources whilst safeguarding historic assets, their settings and local amenity and include sustainable design and construction techniques to increase the re-use and recycling of construction, demolition and excavation waste and reduce the amount disposed to landfill;*
11. *In the case of tall buildings, not adversely affect their surroundings including the local character, cause harm to the significance of heritage assets or impact on important views. Appropriate locations for tall buildings will be defined on a Character Study and may include parts of Uxbridge and Hayes subject to considering the Obstacle Limitation Surfaces for Heathrow Airport. Outside of Uxbridge and Hayes town centres, tall buildings will not be supported. The height of all buildings should be based upon an understanding of the local character and be appropriate to the positive qualities of the surrounding townscape.*

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. *Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.*
2. *Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.*
3. *Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.*
4. *Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.*
5. *Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.*
6. *Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.*
7. *Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular developers should consider bioremediation as part of their proposals.*

8. *Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydro electricty and a greater use of waste as a resource.*
9. *Promoting new development to contribute to the upgrading of existing housing stock where appropriate.*

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. *Locating and designing development to minimise the probability and impacts of flooding.*
11. *Requiring major development proposals to consider the whole water cycle impact, which includes flood risk management, foul and surface water drainage and water consumption.*
12. *Giving preference to development of previously developed land to avoid the loss of further green areas.*
13. *Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.*
14. *Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.*

Local Plan: Part 2 Development Management Policies, adopted January 2020

Policy DMEI 2: Reducing Carbon Emissions

A) *All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.* *
B) *All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.*
C) *Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.*

Policy DMEI 3: Decentralised Energy

A) *All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).*
B) *Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.*
C) *Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a reasonable financial contribution for the future cost of connection and a commitment to connect via a legal*

agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.

D) The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in particular on design and air quality.

Policy DMEI 10: Water Management, Efficiency, and Quality

A) Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B) All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100-year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C) Rain Gardens and non-householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D) Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E) Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F) Developments should be drained by a SuDs system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

<u>Water Efficiency</u>

G) All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.

H) All new development should demonstrate water usage rates of no more than 105 litres/person/day.

<u>Water and Wastewater Infrastructure</u>

J) All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the Local Planning Authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.

3.0 Assessment Methodology

The methodology used has followed that set out in the Energy Assessment Guidance published by the GLA in June 2022.

SAP calculations have been prepared using Part L 2021 to 'test' the Be Lean emissions. This uses the specification for building systems set out in the notional dwelling specification for new dwellings (Part L 2021 - Table 1.1). This includes the use of a gas boiler with an efficiency of 89.5%, a WWHR system and a photovoltaic array with an output (kW) of 40% of the floor area of the unit in question/ (6.5 x number of stories in block).

Further SAP calculations have been prepared for the Be Green scenario, which uses the fabric specification established at the Be Lean stage but includes the actual building systems proposed.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from SAP 10.2 as required by the GLA Energy Assessment Guidance.

	kg CO_2/kWh
Mains gas	0.210
Grid supplied and displaced electricity	0.136

4.0 Proposal

The accommodation schedule in detail is;

Unit Type	Number	Area	Total Area
		m^2	m^2
1-Bedroom apartment	5	50.9	254.5
1-Bedroom apartment	6	53.7	322.2
1-Bedroom apartment	1	63.6	63.6
2-Bedroom apartment	5	69.9	349.5
2-Bedroom apartment	5	70.2	351.0
2-Bedroom apartment	1	70.3	70.3
2-Bedroom apartment	1	71.2	71.2
2-Bedroom apartment	2	73.6	147.2
3-Bedroom apartment	5	73.7	368.5
2-Bedroom apartment	1	75.9	75.9
2-Bedroom apartment	1	76.8	76.8
2-Bedroom apartment	5	79.1	395.5
2-Bedroom apartment	5	80.6	403.0
2-Bedroom apartment	5	81.2	406.0
2-Bedroom apartment	5	83.9	419.5
2-Bedroom apartment	1	87.3	87.3
2-Bedroom apartment	5	89.3	446.5
3-Bedroom apartment	1	96.9	96.9
Total	**60**		**4,405.4**

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The location and design of the building is in context with surrounding development and the shape of the site.

The majority of apartments benefit from at least dual aspects. There are 24 units, which are single aspect but these all have orientations towards the south (18) and north (6). The apartments with a solely northerly aspect are minimised within the context of the shape of the site.

The majority of apartments benefit from access to direct sunlight at some point throughout the day.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight whilst avoiding summer overheating and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the building's heating requirements.

The ground and exposed-floor will be insulated with 200mm 'Kingspan' PIR insulation or similar.

The external walls could be constructed using traditional cavity wall construction over a podium or infill panels within a framed structure. Irrespective of the construction it is assumed the U-values set out below for the external walls can be achieved.

The flat roof will be insulated with 200mm PIR insulation.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m²K	W/m²K	
Ground Floor	**0.18**	**0.11**	**39%**
External Walls	**0.26**	**0.15**	**35%**
Flat Roof	**0.16**	**0.10**	**38%**
Windows	**1.60**	**1.20**	**25%**
Entrance Doors	**1.60**	**1.00**	**38%**

'g' Value to all West, South East Elevations	**0.30**
'g' Value to all North Elevations	**0.50**

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 8 m^3 of air per hour per m^2 of envelope area, at 50Pa. It is proposed to achieve a 63% improvement over Building Regulations and the apartments will target a permeability of 3.0 $m^3/hr/m^2$.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

The thermal details for the building will be modelled at the detailed working drawing stage but for the purposes of this assessment the thermal details formulated by the Concrete Block Association have been used. This will enable the building to achieve the higher energy efficiency requirements of the Building Regulations.

The bridging losses have been based upon the following values;

Reference	Location	PSI Value
		W/mK
E2	Other Lintels (including other steel lintels)	0.058
E3	Sill	0.036
E4	Jamb	0.023
E5	Ground Floor (Normal)	0.165
E7	Party Floor between Dwellings	0.035
E14	Flat Roof	0.041
E16	Corner (normal)	0.041
E17	Corner (inverted)	-0.062
E18	Party Wall	0.037
E20	Exposed Floor	0.103
P1	Exposed Floor	0.160
P3	Intermediate Floor Between Dwellings	0.000

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2021 to address the possibility of overheating and poor air quality.

The Noise Assessment prepared in support of the application recommends that to ensure a suitable internal environment that any energy modelling is to be based upon all windows being closed.

It is therefore proposed to provide a full mechanical ventilation system to the apartments. Consequently, in order to avoid overheating in the apartments the Overheating Assessment has been based on the following ventilation rates;

Apartments to the Lowest Floor	4 air changes per hour (ACH) to Bedrooms
Apartments at Mid Floors	6 ACH to Bedrooms
Apartments at Top Floor	6 ACH to Bedrooms & Living Rooms/ Kitchens

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Part L of the Building Regulations requires all light fitting to have lamps with a minimum luminous efficacy of 85 light source lumens per circuit-watt.

Space Heating and Hot Water

The baseline SAP modelling has been based upon the use of a combination boiler installed to each apartment (as required by the GLA Guidance in order to test the efficiency of the building structure) but the proposed specification is based on the installation of a central VRV system for ducted heating and cooling using heat pumps.

Photovoltaic Panels

The Be Lean calculations have included the installation of photovoltaic panels as required by the GLA Guidance. The quantity included within each (Be Lean) calculation is based on the formula kWp = 40% of dwelling floor area/ (6.5 x number of storeys in block).

5.2 Establishing Carbon Dioxide Emissions (Be Lean)

The GLA Energy Assessment Guidance requires the energy efficiency of a building (Be Lean) to be tested using the building systems set out in Table 1.1 of Part L 2021.

SAP calculations have been prepared for the apartments based on the fabric specification set out above but using the notional systems. These are not the proposed final option but are used to test the 'Be Lean' reductions only.

The TER & DER Worksheets for the modelled units for the 'Be Lean' scenario are attached as Appendix 1 but the emissions from these units can be summarised as follows;

Unit Type	TER	DER
	kg CO_2/yr	kg CO_2/yr
Exposed-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	11.30	11.44
Mid-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	8.72	8.49
Top-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	10.52	11.21
Exposed-floor apartment @ 73.7 m^2 (representing 69.9-76.8 m^2)	15.44	13.79
Mid-floor apartment @ 73.7 m^2 (representing 69.9-76.8 m^2)	12.20	11.55
Top-floor apartment @ 75.9 m^2 (representing 69.9-76.8 m^2)	9.53	10.37
Exposed-floor apartment @ 83.9 m^2 (representing 79.1-96.9 m^2)	11.74	11.26
Mid-floor apartment @ 83.9 m^2 (representing 79.1-96.9 m^2)	8.62	8.35
Top-floor apartment @ 87.3 m^2 (representing 79.1-96.9 m^2)	12.14	11.44

Summary

The SAP calculations have allowed the GLA Carbon Reporting Spreadsheet to be populated.

This accompanies the planning application but from the spreadsheet the total TER emissions for the site are calculated as **45,336 kg CO_2 per year** with Be Lean DER emissions of **44,044 kg CO_2 per year**.

The reduction in emissions is therefore **1,292 kg CO_2 per year**, which equates to a reduction of **2.85%** for the 'Be Lean' case.

It should be noted that the reductions are impacted by the requirement for the windows to the development to be modelled as closed in order to meet the requirements of the Noise Assessment.

Having to model the apartments with closed windows means that in order to pass the Overheating Assessment the 'g' value for the glazing needs to be low, which in turn reduces winter solar gain and hence the energy efficiency of the building.

5.3 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The carbon dioxide emissions established above have been used to test the viability of various renewable and low carbon technologies as follows.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Bath Road to be 4.8 m/s at 10m above ground level and 5.5 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

CHP units are generally gas fuelled and generate electricity with heat being a by-product. The heat is usually used to meet the hot water load, which is fairly consistent throughout the year.

Historically CO_2 savings have been achieved because gas has been used to generate electricity and gas has had a lower emissions factor than electricity, However, with the de-carbonisation of the electricity grid the benefit of CHP is negated and consequently the use of a CHP would increase emissions rather than reduce them.

CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12° C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

The use of ground source heat pumps to this scheme is not appropriate.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

The total hot water demand for the top-floor apartments is 16,154 kWh per year (based on the gas system) and assuming panels would reduce demand by 50% the reduction in CO_2 emissions would be 1,696 kg CO_2 per year.

When combined with the other measures incorporated into the scheme any solar panels would increase the emissions reduction by 3.75%.

This is insufficient to meet the policy target and therefore solar hot water heating panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

The Roof Plan attached as Appendix 3 demonstrate a total of 162 panels could be installed. These will be very gently inclined at around 10 degrees to allow for self-cleaning on racks and orientated towards the south. Assuming the installation of 400W panels the total reduction in emissions from the array will be **7,611 kg CO_2 per year**. This reduction has been incorporated into the Be Green SAP calculations.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps; however, the initial heat energy is extracted from the external air rather than the ground.

The installation of air source heat pumps is appropriate and the analysis set out in 5.4 below considers the use of a Daikin communal heat pump system to the building providing heat to the apartments through VRV units.

5.4 Establishing Carbon Dioxide Emissions (Be Green)

Further SAP calculations have been prepared for the modelled apartments based on the fabric specification set out above but with the actual systems proposed for installation.

These include the installation of a communal air source heat pump to each unit and the installation of 162 x 400W photovoltaic panels on the roof of the building.

The DER Worksheets for the 'Be Green' scenario are attached as Appendix 2 but the emissions from the apartments can be summarised as follows;

Unit Type	Energy Demand DER
	kg CO_2/yr
Exposed-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	-1.21
Mid-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	0.25
Top-floor apartment @ 53.7 m^2 (representing 50.9-63.6 m^2)	0.55
Exposed-floor apartment @ 73.7 m^2 (representing 69.9-76.8 m^2)	0.90
Mid-floor apartment @ 73.7 m^2 (representing 69.9-76.8 m^2)	0.55
Top-floor apartment @ 75.9 m^2 (representing 69.9-76.8 m^2)	0.34
Exposed-floor apartment @ 83.9 m^2 (representing 79.1-96.9 m^2)	0.45
Mid-floor apartment @ 83.9 m^2 (representing 79.1-96.9 m^2)	0.02
Top-floor apartment @ 87.3 m^2 (representing 79.1-96.9 m^2)	0.47

Summary

These emissions have been inputted into the GLA Carbon Emissions Reporting Spreadsheet and from these the total DER emissions for the Be Green scenario are calculated as **1,159 kg CO_2 per year**.

The reduction in emissions is therefore **44,177 kg CO_2 per year**, which equates to a reduction of **97.44%** for the 'Be Green' case.

5.5 Summary of Calculations

Be Lean

SAP calculations have been prepared using Part L 2021 of the Building Regulations.

Based on the Be Lean scenario the total CO_2 emissions are calculated as **45,336 kg CO_2 per year** (TER) and **44,044 kg CO_2 per year** (DER).

This equates to a reduction of **1,292 kg CO_2 per year** or **2.85%** of the total TER emissions. The TER & DER Worksheets for the modelled apartments for the Be Lean scenario are attached as Appendix 1.

It should be noted that the reductions are impacted by the requirement for the windows to the development to be modelled as closed in order to meet the requirements of the Noise Assessment.

Having to model the apartments with closed windows means that in order to pass the Overheating Assessment the 'g' value for the glazing needs to be low, which in turn reduces winter solar gain and hence the energy efficiency of the building.

Be Green

A further set of calculations has been prepared for the proposed energy strategy.

These propose the installation of a communal air source heat pump system as well as a total of 162 x 400W photovoltaic panels installed on the roof of the building.

The panels will be gently inclined on racks and orientated towards the south. A Roof Plan showing the indicative layout of the panels is attached as Appendix 3.

Based on the Be Green scenario the total CO_2 emissions are calculated as **1,159 kg CO_2 per year** (DER).

This equates to a reduction of **44,177 kg CO_2 per year** or **97.44%** of the total TER emissions.

The DER Worksheets for the modelled apartments for the Be Green scenario are attached as Appendix 2.

Summary

The GLA Carbon Emissions Reporting Spreadsheet has been completed and (separately) accompanies this Statement

The residual emissions are **1.159 tonnes**, which requires a carbon offset payment of **£3,303** (based on the carbon offset payment of £2,850 per tonne).

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and therefore has a low probability of flooding.

The existing site is mostly covered with hard surfacing.

Surface Water Management

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the water use target of 110 litres per person per day is achieved.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the apartments:

- water efficient taps
- water efficient toilets
- low output showers
- flow restrictors to manage water pressures to achieve optimum levels and
- water meters

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.

Below is a typical specification, which would achieve the 110 Litres per person per day target (including five litres per person per day allowance for external water use).

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	6/3 litres dual flush	17.64
Basin	2.0 litres/min.	4.74
Shower	9.0 litres/min	39.33
Bath	175 litres	19.25
Sink	5.0 litres/min	12.56
Washing Machine	6.75 litres/kg	14.18
Dishwasher	1.25 litres/places	4.50
		112.20
	Normalisation Factor	0.91
	Total Internal Water Consumption	102.10
	External Water Use	5.00
	Total Water Consumption	107.10

7.0 Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials.

Appendix 1 – TER & DER Worksheets for the Modelled Apartments for the Be Lean scenario

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF EXP 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.15	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

TER WorkSheet: New dwelling design stage

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												
	0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Floor			53.7	x 0.13 =	6.981			(28)
Walls	14.85	10.08	4.77	x 0.18 =	0.86			(29)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party ceiling			53.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16793.1 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.72 (36)

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

TER WorkSheet: New dwelling design stage

Total fabric heat loss (33) + (36) = 26.11 (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=	26.29	26.13	25.97	25.23	25.1	24.45	24.45	24.33	24.7	25.1	25.38	25.67	(38)

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

(39)m=	52.4	52.24	52.08	51.34	51.2	50.56	50.56	50.44	50.81	51.2	51.48	51.77	

Average = Sum(39)$_{1...12}$ /12= 51.34 (39)

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

(40)m=	0.98	0.97	0.97	0.96	0.95	0.94	0.94	0.94	0.95	0.95	0.96	0.96	

Average = Sum(40)$_{1...12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.8 (42)

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

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

TER WorkSheet: New dwelling design stage

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-21.8	-19.18	-19.58	-16.13	-14.99	-12.38	-10.49	-12.7	-13.06	-16.13	-18.66	-21.06	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06	

Output from water heater (annual)$_{1...12}$ 1496.21 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a) 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	7.62	6.77	5.51	4.17	3.12	2.63	2.84	3.7	4.96	6.3	7.35	7.84	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	290.56	290.28	281.45	265.22	249.7	233.4	221.47	226.21	233.07	249.2	269.14	283.41	(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)	
South	0.9x	0.77	5.04		46.75		0.63		0.7	=	144.02	(78)
South	0.9x	0.77	5.04		76.57		0.63		0.7	=	235.87	(78)
South	0.9x	0.77	5.04		97.53		0.63		0.7	=	300.46	(78)
South	0.9x	0.77	5.04		110.23		0.63		0.7	=	339.59	(78)
South	0.9x	0.77	5.04		114.87		0.63		0.7	=	353.87	(78)
South	0.9x	0.77	5.04		110.55		0.63		0.7	=	340.55	(78)
South	0.9x	0.77	5.04		108.01		0.63		0.7	=	332.74	(78)
South	0.9x	0.77	5.04		104.89		0.63		0.7	=	323.14	(78)
South	0.9x	0.77	5.04		101.89		0.63		0.7	=	313.87	(78)
South	0.9x	0.77	5.04		82.59		0.63		0.7	=	254.41	(78)
South	0.9x	0.77	5.04		55.42		0.63		0.7	=	170.72	(78)
South	0.9x	0.77	5.04		40.4		0.63		0.7	=	124.45	(78)

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

(83)m=	144.02	235.87	300.46	339.59	353.87	340.55	332.74	323.14	313.87	254.41	170.72	124.45	(83)

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

(84)m=	434.59	526.16	581.91	604.8	603.56	573.95	554.2	549.35	546.94	503.61	439.86	407.86	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.94	0.87	0.74	0.56	0.4	0.42	0.62	0.88	0.98	0.99	(86)

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

(87)m=	20.08	20.32	20.57	20.8	20.94	20.99	21	21	20.98	20.81	20.41	20.04	(87)

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

(88)m=	20.1	20.11	20.11	20.12	20.12	20.13	20.13	20.13	20.13	20.12	20.12	20.11	(88)

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

(89)m=	0.99	0.97	0.92	0.83	0.68	0.48	0.32	0.34	0.55	0.84	0.97	0.99	(89)

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

(90)m=	19.05	19.35	19.65	19.93	20.07	20.13	20.13	20.13	20.12	19.95	19.47	19	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.35	19.64	19.92	20.18	20.33	20.38	20.39	20.39	20.37	20.2	19.75	19.31	(92)

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

(93)m=	19.35	19.64	19.92	20.18	20.33	20.38	20.39	20.39	20.37	20.2	19.75	19.31	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.92	0.83	0.7	0.5	0.35	0.37	0.57	0.84	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	428.11	506.01	534.36	504.9	420.09	289.59	191.23	200.82	312.94	424.93	424.28	403.34	(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=	788.78	769.76	699.04	579.28	441.65	292.26	191.46	201.15	318.58	491.75	651.05	782.15	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	268.34	177.24	122.52	53.55	16.04	0	0	0	0	49.71	163.27	281.83	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1132.51 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	268.34	177.24	122.52	53.55	16.04	0	0	0	0	49.71	163.27	281.83	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1132.51 (98)

Space heating requirement in kWh/m²/year 21.09 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	268.34	177.24	122.52	53.55	16.04	0	0	0	0	49.71	163.27	281.83	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	296.83	196.07	135.53	59.24	17.74	0	0	0	0	54.99	180.61	311.76	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1252.78 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06

Efficiency of water heater 80.3 (216)

(217)m=	86.56	85.82	84.75	83.12	81.37	80.3	80.3	80.3	80.3	82.93	85.52	86.68

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	169.04	151.93	162.95	147.93	148.52	133.4	126.14	138.98	137.75	151.22	158.45	168.51

Total = Sum(219a)$_{1...12}$ = 1794.82 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1252.78	
Water heating fuel used		1794.82	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		134.63	(232)
Electricity generated by PVs		-452.84	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	263.08	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating	(219) x	0.21	=	376.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =			639.99	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	18.31	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.59	(269)
Total CO2, kg/year	sum of (265)…(271) =			606.92	(272)

TER = 11.3 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF EXP 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7	(1a) x	2.5	(2a) =	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							1	x 10 =	10	(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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.07	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.22	(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) =	0.19	(21)

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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												
	0.24	0.24	0.23	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.21	0.22

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

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Floor			53.7	x 0.11 =	5.907			(28)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party ceiling			53.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16793.1 (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 7.05 (36)

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

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Total fabric heat loss (33) + (36) = 25.22 (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=	23.46	23.41	23.36	23.13	23.08	22.88	22.88	22.84	22.96	23.08	23.17	23.26	(38)

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

(39)m=	48.68	48.63	48.58	48.35	48.3	48.1	48.1	48.06	48.18	48.3	48.39	48.48	

Average = Sum(39)$_{1...12}$ /12= 48.35 (39)

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

(40)m=	0.91	0.91	0.9	0.9	0.9	0.9	0.9	0.89	0.9	0.9	0.9	0.9	

Average = Sum(40)$_{1...12}$ /12= 0.9 (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 1.8 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-37.05	-32.59	-33.27	-27.42	-25.48	-21.04	-17.84	-21.59	-22.2	-27.41	-31.71	-35.8	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32	

Output from water heater (annual)$_{1...12}$ 1358.97 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	287.97	287.99	279.58	263.8	248.64	232.51	220.5	224.96	231.38	247.06	266.65	280.75	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

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

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

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

(84)m=	356.56	400.31	422.66	425.51	417.15	394.68	378.95	378.83	380.84	368.21	347.94	340.01	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.96	0.89	0.74	0.55	0.57	0.8	0.96	0.99	1	(86)

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

(87)m=	20.04	20.19	20.4	20.63	20.84	20.96	20.99	20.99	20.94	20.69	20.31	20.01	(87)

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

(88)m=	20.16	20.16	20.16	20.17	20.17	20.17	20.17	20.17	20.17	20.17	20.17	20.17	(88)

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

(89)m=	1	0.99	0.98	0.94	0.85	0.66	0.45	0.48	0.73	0.94	0.99	1	(89)

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

(90)m=	19.04	19.23	19.49	19.78	20.02	20.15	20.17	20.17	20.13	19.85	19.39	19	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.34	19.52	19.76	20.03	20.26	20.39	20.41	20.41	20.37	20.1	19.66	19.29	(92)

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

(93)m=	19.34	19.52	19.76	20.03	20.26	20.39	20.41	20.41	20.37	20.1	19.66	19.29	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.94	0.86	0.68	0.48	0.51	0.74	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	354.28	394.99	411.03	399.62	357.24	268.03	182.27	191.32	283.43	344.48	343.01	338.34	(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=	732.05	710.82	644	538.11	413.6	278.4	183.35	192.79	301.89	458.8	607.98	731.83	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	281.06	212.24	173.33	99.72	41.93	0	0	0	0	85.06	190.78	292.75	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1376.87 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	281.06	212.24	173.33	99.72	41.93	0	0	0	0	85.06	190.78	292.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1376.87 (98)

Space heating requirement in kWh/m²/year 25.64 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	281.06	212.24	173.33	99.72	41.93	0	0	0	0	85.06	190.78	292.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	310.91	234.78	191.73	110.3	46.39	0	0	0	0	94.09	211.04	323.84	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1523.09 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32

Efficiency of water heater 80.3 (216)

(217)m=	86.92	86.53	85.89	84.77	82.85	80.3	80.3	80.3	80.3	84.32	86.16	87.01

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	150.78	135.19	144.86	131.73	133.2	122.61	116.99	127.92	126.37	135.34	142.12	150.93

Total = Sum(219a)$_{1...12}$ = 1618.03 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1523.09
Water heating fuel used		1618.03
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		88.9 (232)
Electricity generated by PVs		-453.48 (233)

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	319.85	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	339.79	(264)
Space and water heating	(261) + (262) + (263) + (264) =			659.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	4.08	(267)
Electricity for lighting	(232) x	0.136	=	12.09	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.67	(269)
Total CO2, kg/year	sum of (265)…(271) =			614.13	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.44	(273)
EI rating (section 14)				92	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 Beta **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF MID 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.15	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

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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												
	0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.18 =	0.86			(29)
Total area of elements, m²			14.85					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)
Party ceiling			53.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.4 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14913.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 0.96 (36)

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

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Total fabric heat loss (33) + (36) = 13.36 (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=	26.29	26.13	25.97	25.23	25.1	24.45	24.45	24.33	24.7	25.1	25.38	25.67	(38)

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

(39)m=	39.65	39.49	39.33	38.59	38.46	37.81	37.81	37.69	38.06	38.46	38.74	39.03	

Average = Sum(39)$_{1...12}$ /12= 38.59 (39)

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

(40)m=	0.74	0.74	0.73	0.72	0.72	0.7	0.7	0.7	0.71	0.72	0.72	0.73	

Average = Sum(40)$_{1...12}$ /12= 0.72 (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 1.8 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-21.8	-19.18	-19.58	-16.13	-14.99	-12.38	-10.49	-12.7	-13.06	-16.13	-18.66	-21.06	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06	

Output from water heater (annual)$_{1...12}$ 1496.21 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a) 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	7.62	6.77	5.51	4.17	3.12	2.63	2.84	3.7	4.96	6.3	7.35	7.84	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	290.56	290.28	281.45	265.22	249.7	233.4	221.47	226.21	233.07	249.2	269.14	283.41	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.63	x	0.7	=	144.02	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.63	x	0.7	=	235.87	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.63	x	0.7	=	300.46	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.63	x	0.7	=	339.59	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.63	x	0.7	=	353.87	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.63	x	0.7	=	340.55	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.63	x	0.7	=	332.74	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.63	x	0.7	=	323.14	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.63	x	0.7	=	313.87	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.63	x	0.7	=	254.41	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.63	x	0.7	=	170.72	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.63	x	0.7	=	124.45	(78)

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

(83)m=	144.02	235.87	300.46	339.59	353.87	340.55	332.74	323.14	313.87	254.41	170.72	124.45	(83)

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

(84)m=	434.59	526.16	581.91	604.8	603.56	573.95	554.2	549.35	546.94	503.61	439.86	407.86	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.95	0.87	0.74	0.59	0.42	0.3	0.32	0.48	0.76	0.95	0.99	(86)

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

(87)m=	20.49	20.7	20.86	20.96	20.99	21	21	21	21	20.96	20.74	20.45	(87)

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

(88)m=	20.31	20.31	20.31	20.32	20.33	20.34	20.34	20.34	20.33	20.33	20.32	20.32	(88)

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

(89)m=	0.98	0.93	0.85	0.71	0.55	0.38	0.25	0.27	0.43	0.72	0.94	0.99	(89)

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

(90)m=	19.73	19.98	20.17	20.29	20.32	20.34	20.34	20.34	20.33	20.3	20.04	19.69	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.95	20.19	20.38	20.49	20.52	20.53	20.53	20.53	20.53	20.49	20.25	19.91	(92)

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

(93)m=	19.95	20.19	20.38	20.49	20.52	20.53	20.53	20.53	20.53	20.49	20.25	19.91	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.93	0.85	0.72	0.56	0.39	0.27	0.28	0.45	0.73	0.94	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	424.28	489.81	494.52	433.86	337.13	224.18	148.68	155.79	244.35	367.75	411.34	400.87	(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=	620.69	604.03	545.81	447.23	339.16	224.29	148.68	155.8	244.66	380.39	509.32	613.24	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	146.12	76.76	38.16	9.63	1.51	0	0	0	0	9.4	70.54	158	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 510.12 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	146.12	76.76	38.16	9.63	1.51	0	0	0	0	9.4	70.54	158	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 510.12 (98)

Space heating requirement in kWh/m²/year 9.5 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	146.12	76.76	38.16	9.63	1.51	0	0	0	0	9.4	70.54	158	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	161.64	84.91	42.21	10.65	1.67	0	0	0	0	10.4	78.03	174.78	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 564.3 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06

Efficiency of water heater 80.3 (216)

(217)m=	85.05	83.77	82.29	80.96	80.41	80.3	80.3	80.3	80.3	80.93	83.49	85.25

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	172.04	155.66	167.83	151.87	150.29	133.4	126.14	138.98	137.75	154.95	162.3	171.33

Total = Sum(219a)$_{1...12}$ = 1822.54 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		564.3	
Water heating fuel used		1822.54	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		134.63	(232)
Electricity generated by PVs		-452.84	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	118.5	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating	(219) x	0.21	=	382.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			501.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	18.31	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.59	(269)
Total CO2, kg/year	sum of (265)…(271) =			468.16	(272)

TER = 8.72 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF MID 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							1	x 10 =	10	(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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.07	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.22	(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) =	0.19	(21)

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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												
	0.24	0.24	0.23	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.21	0.22

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)

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

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Total area of elements, m²			14.85					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)
Party ceiling			53.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.26 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14913.6 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 0.65 (36)

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

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Total fabric heat loss (33) + (36) = 12.9 (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=	23.46	23.41	23.36	23.13	23.08	22.88	22.88	22.84	22.96	23.08	23.17	23.26	(38)

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

(39)m=	36.37	36.32	36.27	36.03	35.99	35.78	35.78	35.75	35.86	35.99	36.08	36.17	

Average = Sum(39)$_{1...12}$ /12= 36.03 (39)

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

(40)m=	0.68	0.68	0.68	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.8 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-37.05	-32.59	-33.27	-27.42	-25.48	-21.04	-17.84	-21.59	-22.2	-27.41	-31.71	-35.8	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32	

Output from water heater (annual)$_{1...12}$ 1358.97 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	287.97	287.99	279.58	263.8	248.64	232.51	220.5	224.96	231.38	247.06	266.65	280.75	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

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

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

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

(84)m=	356.56	400.31	422.66	425.51	417.15	394.68	378.95	378.83	380.84	368.21	347.94	340.01	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.77	0.58	0.42	0.43	0.64	0.89	0.98	1	(86)

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

(87)m=	20.45	20.58	20.74	20.88	20.97	21	21	21	20.99	20.9	20.65	20.41	(87)

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

(88)m=	20.36	20.36	20.36	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.36	(88)

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

(89)m=	0.99	0.98	0.95	0.87	0.73	0.52	0.36	0.37	0.59	0.87	0.98	0.99	(89)

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

(90)m=	19.72	19.89	20.08	20.25	20.34	20.37	20.37	20.37	20.37	20.28	19.98	19.67	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.93	20.09	20.27	20.44	20.53	20.55	20.56	20.56	20.55	20.46	20.17	19.89	(92)

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

(93)m=	19.93	20.09	20.27	20.44	20.53	20.55	20.56	20.56	20.55	20.46	20.17	19.89	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.74	0.54	0.37	0.39	0.6	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	353.06	390.88	399.97	373.17	308.05	212.32	141.51	148.51	229.56	320.58	339.08	337.57	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	568.42	551.67	499.4	415.68	317.69	213.05	141.55	148.56	231.32	354.84	471.69	567.49	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	160.23	108.05	73.98	30.61	7.17	0	0	0	0	25.49	95.48	171.06	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 672.06 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	160.23	108.05	73.98	30.61	7.17	0	0	0	0	25.49	95.48	171.06	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 672.06 (98)

Space heating requirement in kWh/m²/year 12.52 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	160.23	108.05	73.98	30.61	7.17	0	0	0	0	25.49	95.48	171.06	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	177.25	119.52	81.84	33.86	7.93	0	0	0	0	28.19	105.62	189.22	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 743.43 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32

Efficiency of water heater 80.3 (216)

(217)m=	85.56	84.85	83.79	82.28	80.85	80.3	80.3	80.3	80.3	81.97	84.43	85.72

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	153.19	137.86	148.48	135.72	136.49	122.61	116.99	127.92	126.37	139.22	145.03	153.21

Total = Sum(219a)$_{1...12}$ = 1643.09 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		743.43	
Water heating fuel used		1643.09	
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		88.9	(232)
Electricity generated by PVs		-453.48	(233)

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	156.12	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	345.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			501.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	4.08	(267)
Electricity for lighting	(232) x	0.136	=	12.09	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.67	(269)
Total CO2, kg/year	sum of (265)…(271) =			455.67	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			8.49	(273)
EI rating (section 14)				94	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF TOP 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.15	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.4	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

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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												
	0.43	0.42	0.42	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.4

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.18 =	0.86			(29)
Roof	53.7	0	53.7	x 0.11 =	5.72			(30)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.12 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13785.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.33 (36)

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

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Total fabric heat loss (33) + (36) = 22.45 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	26.29	26.13	25.97	25.23	25.1	24.45	24.45	24.33	24.7	25.1	25.38	25.67	(38)

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

(39)m=	48.74	48.58	48.43	47.69	47.55	46.9	46.9	46.78	47.15	47.55	47.83	48.12	

Average = Sum(39)$_{1...12}$ /12= 47.69 (39)

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

(40)m=	0.91	0.9	0.9	0.89	0.89	0.87	0.87	0.87	0.88	0.89	0.89	0.9	

Average = Sum(40)$_{1...12}$ /12= 0.89 (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 1.8 (42)

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

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-21.8	-19.18	-19.58	-16.13	-14.99	-12.38	-10.49	-12.7	-13.06	-16.13	-18.66	-21.06	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06	

Output from water heater (annual)$_{1...12}$ 1496.21 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a) 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	7.62	6.77	5.51	4.17	3.12	2.63	2.84	3.7	4.96	6.3	7.35	7.84	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	290.56	290.28	281.45	265.22	249.7	233.4	221.47	226.21	233.07	249.2	269.14	283.41	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.63	x	0.7	=	144.02	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.63	x	0.7	=	235.87	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.63	x	0.7	=	300.46	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.63	x	0.7	=	339.59	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.63	x	0.7	=	353.87	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.63	x	0.7	=	340.55	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.63	x	0.7	=	332.74	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.63	x	0.7	=	323.14	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.63	x	0.7	=	313.87	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.63	x	0.7	=	254.41	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.63	x	0.7	=	170.72	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.63	x	0.7	=	124.45	(78)

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

(83)m=	144.02	235.87	300.46	339.59	353.87	340.55	332.74	323.14	313.87	254.41	170.72	124.45	(83)

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

(84)m=	434.59	526.16	581.91	604.8	603.56	573.95	554.2	549.35	546.94	503.61	439.86	407.86	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.84	0.7	0.52	0.37	0.39	0.59	0.85	0.97	0.99	(86)

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

(87)m=	20.2	20.43	20.66	20.86	20.96	20.99	21	21	20.99	20.86	20.5	20.16	(87)

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

(88)m=	20.16	20.16	20.17	20.18	20.18	20.19	20.19	20.19	20.19	20.18	20.18	20.17	(88)

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

(89)m=	0.99	0.96	0.91	0.81	0.65	0.46	0.3	0.32	0.52	0.81	0.96	0.99	(89)

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

(90)m=	19.24	19.53	19.81	20.04	20.15	20.19	20.19	20.19	20.18	20.06	19.63	19.19	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.52	19.8	20.06	20.28	20.39	20.42	20.43	20.43	20.42	20.3	19.89	19.48	(92)

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

(93)m=	19.52	19.8	20.06	20.28	20.39	20.42	20.43	20.43	20.42	20.3	19.89	19.48	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.91	0.81	0.66	0.47	0.32	0.34	0.54	0.82	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	427.54	503.37	527.27	490.32	399.95	271.87	179.45	188.36	294.86	413.38	422.21	402.98	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	741.93	723.7	656.63	542.75	413.08	273.21	179.55	188.51	297.89	461	611.69	735.05	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	233.91	148.06	96.24	37.75	9.77	0	0	0	0	35.43	136.43	247.06	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 944.65 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	233.91	148.06	96.24	37.75	9.77	0	0	0	0	35.43	136.43	247.06	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 944.65 (98)

Space heating requirement in kWh/m²/year 17.59 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	233.91	148.06	96.24	37.75	9.77	0	0	0	0	35.43	136.43	247.06	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	258.75	163.78	106.46	41.76	10.81	0	0	0	0	39.2	150.91	273.3	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1044.97 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	146.32	130.4	138.11	122.95	120.85	107.12	101.29	111.6	110.61	125.4	135.51	146.06

Efficiency of water heater 80.3 (216)

(217)m=	86.23	85.37	84.16	82.46	80.98	80.3	80.3	80.3	80.3	82.33	85.07	86.36

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	169.69	152.74	164.1	149.1	149.24	133.4	126.14	138.98	137.75	152.33	159.29	169.12

Total = Sum(219a)$_{1...12}$ = 1801.87 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1044.97	
Water heating fuel used		1801.87	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		134.63	(232)
Electricity generated by PVs		-452.84	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	219.44	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating	(219) x	0.21	=	378.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =			597.84	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	18.31	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.59	(269)
Total CO2, kg/year	sum of (265)…(271) =			564.76	(272)

TER = 10.52 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF TOP 54 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7	(1a) x	2.5	(2a) =	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							1	x 10 =	10	(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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.07	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.22	(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) =	0.19	(21)

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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												
	0.24	0.24	0.23	0.21	0.21	0.18	0.18	0.18	0.19	0.21	0.21	0.22

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

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

(25)m=	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Roof	53.7	0	53.7	x 0.1 =	5.37			(30)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13785.9 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.69 (36)

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

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Total fabric heat loss (33) + (36) = 24.31 (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=	23.46	23.41	23.36	23.13	23.08	22.88	22.88	22.84	22.96	23.08	23.17	23.26	(38)

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

(39)m=	47.78	47.73	47.68	47.44	47.4	47.19	47.19	47.15	47.27	47.4	47.49	47.58	

Average = Sum(39)$_{1...12}$ /12= 47.44 (39)

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

(40)m=	0.89	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.89	

Average = Sum(40)$_{1...12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.8 (42)

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

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

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

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	18.13	15.79	16.83	15.65	15.52	14.39	14.87	15.51	15.64	16.82	16.92	18.14	(61)

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

(62)m=	168.12	149.57	157.68	139.08	135.84	119.5	111.78	124.3	123.67	141.53	154.16	167.13	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-37.05	-32.59	-33.27	-27.42	-25.48	-21.04	-17.84	-21.59	-22.2	-27.41	-31.71	-35.8	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32	

Output from water heater (annual)$_{1...12}$ 1358.97 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	54.4	48.43	51.04	44.95	43.89	38.55	35.94	40.05	39.83	45.67	49.86	54.07	(65)

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

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

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

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

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

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	73.12	72.07	68.6	62.44	58.99	53.54	48.31	53.83	55.32	61.39	69.26	72.68	(72)

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

(73)m=	287.97	287.99	279.58	263.8	248.64	232.51	220.5	224.96	231.38	247.06	266.65	280.75	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

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

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

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

(84)m=	356.56	400.31	422.66	425.51	417.15	394.68	378.95	378.83	380.84	368.21	347.94	340.01	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.88	0.73	0.54	0.57	0.79	0.95	0.99	1	(86)

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

(87)m=	20.07	20.22	20.42	20.65	20.85	20.97	21	20.99	20.94	20.7	20.34	20.03	(87)

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

(88)m=	20.18	20.18	20.18	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.18	20.18	(88)

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

(89)m=	1	0.99	0.98	0.94	0.85	0.65	0.44	0.47	0.72	0.93	0.99	1	(89)

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

(90)m=	19.09	19.28	19.53	19.82	20.05	20.17	20.18	20.18	20.15	19.89	19.43	19.05	(90)

fLA = Living area ÷ (4) = 0.29 (91)

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

(92)m=	19.38	19.56	19.79	20.06	20.28	20.4	20.42	20.42	20.38	20.13	19.7	19.34	(92)

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

(93)m=	19.38	19.56	19.79	20.06	20.28	20.4	20.42	20.42	20.38	20.13	19.7	19.34	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.94	0.85	0.67	0.47	0.5	0.74	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	354.25	394.86	410.66	398.64	355	264.68	179.5	188.42	280.45	343.59	342.89	338.33	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	720.44	699.54	633.78	529.51	406.9	273.79	180.4	189.67	296.94	451.51	598.34	720.16	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	272.45	204.74	166	94.23	38.61	0	0	0	0	80.3	183.92	284.09	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1324.33 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	272.45	204.74	166	94.23	38.61	0	0	0	0	80.3	183.92	284.09	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1324.33 (98)

Space heating requirement in kWh/m²/year 24.66 (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 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	272.45	204.74	166	94.23	38.61	0	0	0	0	80.3	183.92	284.09	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	301.38	226.49	183.63	104.23	42.71	0	0	0	0	88.83	203.46	314.25	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1464.97 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	131.06	116.98	124.41	111.66	110.36	98.46	93.95	102.72	101.47	114.12	122.45	131.32

Efficiency of water heater 80.3 (216)

(217)m=	86.85	86.45	85.78	84.63	82.69	80.3	80.3	80.3	80.3	84.18	86.07	86.94

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	150.91	135.32	145.04	131.95	133.45	122.61	116.99	127.92	126.37	135.56	142.27	151.05

Total = Sum(219a)$_{1...12}$ = 1619.43 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1464.97
Water heating fuel used		1619.43
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		88.9 (232)
Electricity generated by PVs		-453.48 (233)

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	307.64	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	340.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =			647.72	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	4.08	(267)
Electricity for lighting	(232) x	0.136	=	12.09	(268)
Energy saving/generation technologies Item 1		0.136	=	-61.67	(269)
Total CO2, kg/year	sum of (265)…(271) =			602.22	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.21	(273)
EI rating (section 14)				92	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 74 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7	(1a) x	2.5	(2a) =	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (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)

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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												
	0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(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	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Windows Type 2			3.62	x1/[1/(1.2)+ 0.04] =	4.15			(27)
Windows Type 3			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Windows Type 4			2.58	x1/[1/(1.2)+ 0.04] =	2.95			(27)
Windows Type 5			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Floor			73.7	x 0.13 =	9.580999			(28)
Walls	75.43	18.42	57.01	x 0.18 =	10.26			(29)
Total area of elements, m²			149.13					(31)
Party wall			28.55	x 0 =	0			(32)
Party ceiling			73.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 40.93 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16298.1 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 14.04 (36)

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

Total fabric heat loss — (33) + (36) = — 54.98 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	36.49	36.25	36.02	34.93	34.73	33.78	33.78	33.6	34.14	34.73	35.14	35.57	(38)

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

(39)m=	91.46	91.23	90.99	89.91	89.7	88.76	88.76	88.58	89.12	89.7	90.11	90.55	

Average = Sum(39)$_{1...12}$ /12= 89.91 (39)

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

(40)m=	1.24	1.24	1.23	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.22	1.23	

Average = Sum(40)$_{1...12}$ /12= 1.22 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.33 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

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

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.06	18.34	19.55	18.18	18.03	16.71	17.26	18.02	18.17	19.54	19.65	21.07	(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=	195.83	174.23	183.67	162.01	158.22	139.19	130.19	144.78	144.05	164.86	179.57	194.67	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-27.01	-23.77	-24.26	-19.97	-18.55	-15.3	-12.96	-15.69	-16.14	-19.95	-23.1	-26.11	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	168.81	150.46	159.41	142.04	139.68	123.88	117.23	129.09	127.91	144.91	156.48	168.56	

Output from water heater (annual)$_{1...12}$ 1728.46 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	63.38	56.42	59.46	52.37	51.12	44.9	41.87	46.65	46.4	53.2	58.09	62.99	(65)

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

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

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

(67)m=	9.86	8.75	7.12	5.39	4.03	3.4	3.67	4.78	6.41	8.14	9.5	10.13	(67)

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

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

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

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	85.18	83.96	79.92	72.73	68.71	62.36	56.27	62.71	64.44	71.51	80.68	84.66	(72)

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

(73)m=	361.8	361.61	350.55	330.18	310.34	289.77	274.88	280.28	289.03	309.28	334.27	352.48	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x 0.77	x	3.62	x	10.63	x	0.63	x	0.7	=	23.53	(74)
North	0.9x 0.77	x	1.72	x	10.63	x	0.63	x	0.7	=	11.18	(74)
North	0.9x 0.77	x	2.58	x	10.63	x	0.63	x	0.7	=	8.38	(74)
North	0.9x 0.77	x	3.62	x	20.32	x	0.63	x	0.7	=	44.96	(74)
North	0.9x 0.77	x	1.72	x	20.32	x	0.63	x	0.7	=	21.36	(74)
North	0.9x 0.77	x	2.58	x	20.32	x	0.63	x	0.7	=	16.02	(74)
North	0.9x 0.77	x	3.62	x	34.53	x	0.63	x	0.7	=	76.4	(74)
North	0.9x 0.77	x	1.72	x	34.53	x	0.63	x	0.7	=	36.3	(74)
North	0.9x 0.77	x	2.58	x	34.53	x	0.63	x	0.7	=	27.23	(74)
North	0.9x 0.77	x	3.62	x	55.46	x	0.63	x	0.7	=	122.72	(74)
North	0.9x 0.77	x	1.72	x	55.46	x	0.63	x	0.7	=	58.31	(74)
North	0.9x 0.77	x	2.58	x	55.46	x	0.63	x	0.7	=	43.73	(74)
North	0.9x 0.77	x	3.62	x	74.72	x	0.63	x	0.7	=	165.32	(74)
North	0.9x 0.77	x	1.72	x	74.72	x	0.63	x	0.7	=	78.55	(74)
North	0.9x 0.77	x	2.58	x	74.72	x	0.63	x	0.7	=	58.91	(74)
North	0.9x 0.77	x	3.62	x	79.99	x	0.63	x	0.7	=	176.98	(74)
North	0.9x 0.77	x	1.72	x	79.99	x	0.63	x	0.7	=	84.09	(74)
North	0.9x 0.77	x	2.58	x	79.99	x	0.63	x	0.7	=	63.07	(74)
North	0.9x 0.77	x	3.62	x	74.68	x	0.63	x	0.7	=	165.23	(74)
North	0.9x 0.77	x	1.72	x	74.68	x	0.63	x	0.7	=	78.51	(74)
North	0.9x 0.77	x	2.58	x	74.68	x	0.63	x	0.7	=	58.88	(74)
North	0.9x 0.77	x	3.62	x	59.25	x	0.63	x	0.7	=	131.09	(74)
North	0.9x 0.77	x	1.72	x	59.25	x	0.63	x	0.7	=	62.29	(74)
North	0.9x 0.77	x	2.58	x	59.25	x	0.63	x	0.7	=	46.71	(74)

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North	0.9x	0.77	x	3.62	x	41.52	x	0.63	x	0.7	=	91.86	(74)
North	0.9x	0.77	x	1.72	x	41.52	x	0.63	x	0.7	=	43.65	(74)
North	0.9x	0.77	x	2.58	x	41.52	x	0.63	x	0.7	=	32.74	(74)
North	0.9x	0.77	x	3.62	x	24.19	x	0.63	x	0.7	=	53.52	(74)
North	0.9x	0.77	x	1.72	x	24.19	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	2.58	x	24.19	x	0.63	x	0.7	=	19.07	(74)
North	0.9x	0.77	x	3.62	x	13.12	x	0.63	x	0.7	=	29.02	(74)
North	0.9x	0.77	x	1.72	x	13.12	x	0.63	x	0.7	=	13.79	(74)
North	0.9x	0.77	x	2.58	x	13.12	x	0.63	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.62	x	8.86	x	0.63	x	0.7	=	19.61	(74)
North	0.9x	0.77	x	1.72	x	8.86	x	0.63	x	0.7	=	9.32	(74)
North	0.9x	0.77	x	2.58	x	8.86	x	0.63	x	0.7	=	6.99	(74)
East	0.9x	0.77	x	1.72	x	19.64	x	0.63	x	0.7	=	10.32	(76)
East	0.9x	0.77	x	1.72	x	38.42	x	0.63	x	0.7	=	20.2	(76)
East	0.9x	0.77	x	1.72	x	63.27	x	0.63	x	0.7	=	33.26	(76)
East	0.9x	0.77	x	1.72	x	92.28	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.72	x	113.09	x	0.63	x	0.7	=	59.45	(76)
East	0.9x	0.77	x	1.72	x	115.77	x	0.63	x	0.7	=	60.86	(76)
East	0.9x	0.77	x	1.72	x	110.22	x	0.63	x	0.7	=	57.94	(76)
East	0.9x	0.77	x	1.72	x	94.68	x	0.63	x	0.7	=	49.77	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	1.72	x	45.59	x	0.63	x	0.7	=	23.96	(76)
East	0.9x	0.77	x	1.72	x	24.49	x	0.63	x	0.7	=	12.87	(76)
East	0.9x	0.77	x	1.72	x	16.15	x	0.63	x	0.7	=	8.49	(76)
West	0.9x	0.77	x	1.72	x	19.64	x	0.63	x	0.7	=	20.65	(80)
West	0.9x	0.77	x	1.72	x	38.42	x	0.63	x	0.7	=	40.39	(80)
West	0.9x	0.77	x	1.72	x	63.27	x	0.63	x	0.7	=	66.52	(80)
West	0.9x	0.77	x	1.72	x	92.28	x	0.63	x	0.7	=	97.01	(80)
West	0.9x	0.77	x	1.72	x	113.09	x	0.63	x	0.7	=	118.9	(80)
West	0.9x	0.77	x	1.72	x	115.77	x	0.63	x	0.7	=	121.71	(80)
West	0.9x	0.77	x	1.72	x	110.22	x	0.63	x	0.7	=	115.87	(80)
West	0.9x	0.77	x	1.72	x	94.68	x	0.63	x	0.7	=	99.53	(80)
West	0.9x	0.77	x	1.72	x	73.59	x	0.63	x	0.7	=	77.37	(80)
West	0.9x	0.77	x	1.72	x	45.59	x	0.63	x	0.7	=	47.93	(80)
West	0.9x	0.77	x	1.72	x	24.49	x	0.63	x	0.7	=	25.75	(80)
West	0.9x	0.77	x	1.72	x	16.15	x	0.63	x	0.7	=	16.98	(80)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	74.06	142.94	239.71	370.29	481.12	506.7	476.43	389.39	284.29	169.92	91.78	61.39	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	435.86	504.54	590.26	700.47	791.47	796.47	751.31	669.67	573.32	479.2	426.05	413.87	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	1	0.99	0.95	0.85	0.67	0.51	0.59	0.86	0.98	1	1	(86)

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

(87)m=	19.44	19.62	19.95	20.4	20.77	20.95	20.99	20.98	20.82	20.33	19.81	19.41	(87)

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

(88)m=	19.89	19.89	19.89	19.9	19.91	19.92	19.92	19.92	19.91	19.91	19.9	19.9	(88)

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

(89)m=	1	0.99	0.98	0.94	0.8	0.57	0.39	0.46	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=	18.07	18.3	18.72	19.29	19.71	19.89	19.91	19.91	19.79	19.22	18.56	18.04	(90)

fLA = Living area ÷ (4) =	0.35	(91)

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

(92)m=	18.55	18.76	19.15	19.68	20.08	20.26	20.29	20.28	20.15	19.61	19	18.52	(92)

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

(93)m=	18.55	18.76	19.15	19.68	20.08	20.26	20.29	20.28	20.15	19.61	19	18.52	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.81	0.6	0.43	0.5	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	434.23	500.63	577.94	652.13	637.71	480.88	324.13	337.34	459.76	462.58	422.93	412.65	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1303.09	1264.45	1150.94	968.87	751.77	502.19	327.46	344.09	539.04	808.42	1072.04	1296.73	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	646.44	513.29	426.31	228.05	84.86	0	0	0	0	257.31	467.35	657.75	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ =	3281.36	(97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ =	0	(97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	646.44	513.29	426.31	228.05	84.86	0	0	0	0	257.31	467.35	657.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	3281.36	(98)
Space heating requirement in kWh/m²/year	44.52	(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)

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Efficiency of main space heating system 1	90.4	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	646.44	513.29	426.31	228.05	84.86	0	0	0	0	257.31	467.35	657.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	715.08	567.79	471.58	252.27	93.87	0	0	0	0	284.64	516.99	727.6	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3629.83 (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)

	168.81	150.46	159.41	142.04	139.68	123.88	117.23	129.09	127.91	144.91	156.48	168.56	

Efficiency of water heater 80.3 (216)

(217)m=	88.11	87.89	87.41	86.24	83.84	80.3	80.3	80.3	80.3	86.48	87.64	88.14	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	191.6	171.19	182.38	164.7	166.6	154.27	146	160.77	159.29	167.56	178.55	191.25	

Total = Sum(219a)$_{1...12}$ = 2034.15 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3629.83
Water heating fuel used		2034.15
Electricity for pumps, fans and electric keep-hot		
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75 (231)
Electricity for lighting		174.05 (232)
Electricity generated by PVs		-625.75 (233)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x		0.21	=	762.26	(261)
Space heating (secondary)	(215) x		0.136	=	0	(263)
Water heating	(219) x		0.21	=	427.17	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1189.44	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.136	=	10.2	(267)
Electricity for lighting	(232) x		0.136	=	23.67	(268)
Energy saving/generation technologies						

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Item 1	0.136	=	-85.1	(269)
Total CO2, kg/year	sum of (265)…(271) =		1138.2	(272)
TER =			15.44	(273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 74 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7 (1a)	x	2.5 (2a)	=	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							1	x 10 =	10	(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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.05	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.2	(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) =	0.17	(21)

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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												
	0.22	0.22	0.21	0.19	0.19	0.16	0.16	0.16	0.17	0.19	0.2	0.2

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)
(24d)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(24d)

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

(25)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(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			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 2			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 5			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Floor			73.7	x 0.11 =	8.106999			(28)
Walls	75.43	25.68	49.75	x 0.15 =	7.46			(29)
Total area of elements, m²			149.13					(31)
Party wall			28.55	x 0 =	0			(32)
Party ceiling			73.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 44.97 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15862.5 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 7.52 (36)

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

Total fabric heat loss (33) + (36) = — 52.49 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.89	31.83	31.78	31.51	31.46	31.23	31.23	31.19	31.32	31.46	31.56	31.67	(38)

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

(39)m=	84.38	84.33	84.27	84	83.95	83.72	83.72	83.68	83.81	83.95	84.05	84.16	

Average = Sum(39)$_{1...12}$ /12= 84 (39)

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

(40)m=	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	

Average = Sum(40)$_{1...12}$ /12= 1.14 (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 — 2.33 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

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

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.06	18.34	19.55	18.18	18.03	16.71	17.26	18.02	18.17	19.54	19.65	21.07	(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=	195.83	174.23	183.67	162.01	158.22	139.19	130.19	144.78	144.05	164.86	179.57	194.67	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-45.91	-40.4	-41.23	-33.94	-31.52	-26.01	-22.03	-26.67	-27.44	-33.91	-39.26	-44.37	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	149.91	133.83	142.44	128.06	126.7	113.17	108.17	118.12	116.61	130.95	140.32	150.3	

Output from water heater (annual)$_{1...12}$ 1558.59 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	63.38	56.42	59.46	52.37	51.12	44.9	41.87	46.65	46.4	53.2	58.09	62.99	(65)

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

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

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

(67)m=	6.49	5.76	4.69	3.55	2.65	2.24	2.42	3.14	4.22	5.36	6.25	6.67	(67)

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

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

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

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	85.18	83.96	79.92	72.73	68.71	62.36	56.27	62.71	64.44	71.51	80.68	84.66	(72)

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

(73)m=	358.43	358.61	348.12	328.34	308.97	288.61	273.62	278.65	286.84	306.5	331.02	349.01	(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)	
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	3.6	x	10.63	x	0.5	x	0.7	=	9.28	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	3.6	x	20.32	x	0.5	x	0.7	=	17.74	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	3.6	x	34.53	x	0.5	x	0.7	=	30.15	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	3.6	x	55.46	x	0.5	x	0.7	=	48.43	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	3.6	x	74.72	x	0.5	x	0.7	=	65.24	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	3.6	x	79.99	x	0.5	x	0.7	=	69.84	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	3.6	x	74.68	x	0.5	x	0.7	=	65.21	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	3.6	x	59.25	x	0.5	x	0.7	=	51.73	(74)

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North	0.9x	0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.5	x	0.7	=	36.25	(74)
North	0.9x	0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.5	x	0.7	=	21.12	(74)
North	0.9x	0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.5	x	0.7	=	11.45	(74)
North	0.9x	0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.5	x	0.7	=	7.74	(74)
East	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(76)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	13.72	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	26.84	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	44.2	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	64.46	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	79	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	80.87	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	76.99	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	66.14	(80)
West	0.9x	0.77	x	2.4	x	73.59	x	0.3	x	0.7	=	51.41	(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	31.85	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	17.11	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	11.28	(80)

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

(83)m=	68.24	131.34	221.07	345.3	453.4	479.83	450.21	364.76	263.2	156.19	84.46	56.66	(83)

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

(84)m=	426.67	489.96	569.19	673.64	762.37	768.44	723.83	643.41	550.04	462.69	415.48	405.67	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	1	0.99	0.95	0.84	0.66	0.5	0.58	0.86	0.98	1	1	(86)

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

(87)m=	19.57	19.73	20.04	20.46	20.8	20.96	20.99	20.98	20.84	20.39	19.9	19.53	(87)

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

(88)m=	19.96	19.96	19.97	19.97	19.97	19.97	19.97	19.97	19.97	19.97	19.97	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	0.79	0.57	0.39	0.46	0.79	0.97	1	1	(89)

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

(90)m=	18.29	18.5	18.89	19.41	19.8	19.95	19.97	19.97	19.86	19.34	18.72	18.24	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	18.74	18.93	19.29	19.78	20.15	20.3	20.33	20.32	20.2	19.71	19.13	18.69	(92)

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

(93)m=	18.74	18.93	19.29	19.78	20.15	20.3	20.33	20.32	20.2	19.71	19.13	18.69	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.93	0.8	0.6	0.43	0.5	0.8	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	425.27	486.59	558.28	628.72	612.75	460.23	309.52	322.81	441.97	447.61	412.75	404.63	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1218.32	1183.38	1078.15	913.64	709.56	477.3	312.01	328.17	511.5	764.47	1011.39	1219.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	590.02	468.25	386.78	205.14	72.03	0	0	0	0	235.74	431.02	606.5	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2995.48 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	590.02	468.25	386.78	205.14	72.03	0	0	0	0	235.74	431.02	606.5	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2995.48 (98)

Space heating requirement in kWh/m²/year 40.64 (99)

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

Space heating:

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

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

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

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Efficiency of main space heating system 1 — 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	590.02	468.25	386.78	205.14	72.03	0	0	0	0	235.74	431.02	606.5	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	652.68	517.97	427.85	226.93	79.68	0	0	0	0	260.78	476.79	670.9	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 3313.59 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	149.91	133.83	142.44	128.06	126.7	113.17	108.17	118.12	116.61	130.95	140.32	150.3

Efficiency of water heater — 80.3 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	88.15	87.94	87.44	86.23	83.69	80.3	80.3	80.3	80.3	86.51	87.69	88.2	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	170.06	152.19	162.9	148.51	151.39	140.94	134.7	147.1	145.22	151.36	160.01	170.41

Total = Sum(219a)$_{1...12}$ = 1834.8 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3313.59
Water heating fuel used		1834.8
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		114.56 (232)
Electricity generated by PVs		-622.37 (233)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x		0.21	=	695.85	(261)
Space heating (secondary)	(215) x		0.136	=	0	(263)
Water heating	(219) x		0.21	=	385.31	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1081.16	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.136	=	4.08	(267)
Electricity for lighting	(232) x		0.136	=	15.58	(268)
Energy saving/generation technologies Item 1			0.136	=	-84.64	(269)

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Total CO2, kg/year	sum of (265)…(271) =	1016.18	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	13.79	(273)
EI rating (section 14)		89	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 74 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7	(1a) x	2.5	(2a) =	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (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)

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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												
	0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(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	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Windows Type 2			3.62	x1/[1/(1.2)+ 0.04] =	4.15			(27)
Windows Type 3			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Windows Type 4			2.58	x1/[1/(1.2)+ 0.04] =	2.95			(27)
Windows Type 5			1.72	x1/[1/(1.2)+ 0.04] =	1.97			(27)
Walls	75.43	18.42	57.01	x 0.18 =	10.26			(29)
Total area of elements, m²			75.43					(31)
Party wall			28.55	x 0 =	0			(32)
Party floor			73.7					(32a)
Party ceiling			73.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 31.35 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13718.6 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 4.67 (36)

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

Total fabric heat loss (33) + (36) = — 36.03 (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=	36.49	36.25	36.02	34.93	34.73	33.78	33.78	33.6	34.14	34.73	35.14	35.57	(38)

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

(39)m=	72.51	72.28	72.04	70.96	70.75	69.8	69.8	69.63	70.17	70.75	71.16	71.59	

Average = Sum(39)$_{1...12}$ /12= 70.95 (39)

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

(40)m=	0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.94	0.95	0.96	0.97	0.97	

Average = Sum(40)$_{1...12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.33 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

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

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.06	18.34	19.55	18.18	18.03	16.71	17.26	18.02	18.17	19.54	19.65	21.07	(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=	195.83	174.23	183.67	162.01	158.22	139.19	130.19	144.78	144.05	164.86	179.57	194.67	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-27.01	-23.77	-24.26	-19.97	-18.55	-15.3	-12.96	-15.69	-16.14	-19.95	-23.1	-26.11	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	168.81	150.46	159.41	142.04	139.68	123.88	117.23	129.09	127.91	144.91	156.48	168.56	

Output from water heater (annual)$_{1...12}$ 1728.46 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	63.38	56.42	59.46	52.37	51.12	44.9	41.87	46.65	46.4	53.2	58.09	62.99	(65)

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

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

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

(67)m=	9.86	8.75	7.12	5.39	4.03	3.4	3.67	4.78	6.41	8.14	9.5	10.13	(67)

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

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

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

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	85.18	83.96	79.92	72.73	68.71	62.36	56.27	62.71	64.44	71.51	80.68	84.66	(72)

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

(73)m=	361.8	361.61	350.55	330.18	310.34	289.77	274.88	280.28	289.03	309.28	334.27	352.48	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x 0.77	x	3.62	x	10.63	x	0.63	x	0.7	=	23.53	(74)
North	0.9x 0.77	x	1.72	x	10.63	x	0.63	x	0.7	=	11.18	(74)
North	0.9x 0.77	x	2.58	x	10.63	x	0.63	x	0.7	=	8.38	(74)
North	0.9x 0.77	x	3.62	x	20.32	x	0.63	x	0.7	=	44.96	(74)
North	0.9x 0.77	x	1.72	x	20.32	x	0.63	x	0.7	=	21.36	(74)
North	0.9x 0.77	x	2.58	x	20.32	x	0.63	x	0.7	=	16.02	(74)
North	0.9x 0.77	x	3.62	x	34.53	x	0.63	x	0.7	=	76.4	(74)
North	0.9x 0.77	x	1.72	x	34.53	x	0.63	x	0.7	=	36.3	(74)
North	0.9x 0.77	x	2.58	x	34.53	x	0.63	x	0.7	=	27.23	(74)
North	0.9x 0.77	x	3.62	x	55.46	x	0.63	x	0.7	=	122.72	(74)
North	0.9x 0.77	x	1.72	x	55.46	x	0.63	x	0.7	=	58.31	(74)
North	0.9x 0.77	x	2.58	x	55.46	x	0.63	x	0.7	=	43.73	(74)
North	0.9x 0.77	x	3.62	x	74.72	x	0.63	x	0.7	=	165.32	(74)
North	0.9x 0.77	x	1.72	x	74.72	x	0.63	x	0.7	=	78.55	(74)
North	0.9x 0.77	x	2.58	x	74.72	x	0.63	x	0.7	=	58.91	(74)
North	0.9x 0.77	x	3.62	x	79.99	x	0.63	x	0.7	=	176.98	(74)
North	0.9x 0.77	x	1.72	x	79.99	x	0.63	x	0.7	=	84.09	(74)
North	0.9x 0.77	x	2.58	x	79.99	x	0.63	x	0.7	=	63.07	(74)
North	0.9x 0.77	x	3.62	x	74.68	x	0.63	x	0.7	=	165.23	(74)
North	0.9x 0.77	x	1.72	x	74.68	x	0.63	x	0.7	=	78.51	(74)
North	0.9x 0.77	x	2.58	x	74.68	x	0.63	x	0.7	=	58.88	(74)
North	0.9x 0.77	x	3.62	x	59.25	x	0.63	x	0.7	=	131.09	(74)
North	0.9x 0.77	x	1.72	x	59.25	x	0.63	x	0.7	=	62.29	(74)
North	0.9x 0.77	x	2.58	x	59.25	x	0.63	x	0.7	=	46.71	(74)

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North	0.9x	0.77	x	3.62	x	41.52	x	0.63	x	0.7	=	91.86	(74)
North	0.9x	0.77	x	1.72	x	41.52	x	0.63	x	0.7	=	43.65	(74)
North	0.9x	0.77	x	2.58	x	41.52	x	0.63	x	0.7	=	32.74	(74)
North	0.9x	0.77	x	3.62	x	24.19	x	0.63	x	0.7	=	53.52	(74)
North	0.9x	0.77	x	1.72	x	24.19	x	0.63	x	0.7	=	25.43	(74)
North	0.9x	0.77	x	2.58	x	24.19	x	0.63	x	0.7	=	19.07	(74)
North	0.9x	0.77	x	3.62	x	13.12	x	0.63	x	0.7	=	29.02	(74)
North	0.9x	0.77	x	1.72	x	13.12	x	0.63	x	0.7	=	13.79	(74)
North	0.9x	0.77	x	2.58	x	13.12	x	0.63	x	0.7	=	10.34	(74)
North	0.9x	0.77	x	3.62	x	8.86	x	0.63	x	0.7	=	19.61	(74)
North	0.9x	0.77	x	1.72	x	8.86	x	0.63	x	0.7	=	9.32	(74)
North	0.9x	0.77	x	2.58	x	8.86	x	0.63	x	0.7	=	6.99	(74)
East	0.9x	0.77	x	1.72	x	19.64	x	0.63	x	0.7	=	10.32	(76)
East	0.9x	0.77	x	1.72	x	38.42	x	0.63	x	0.7	=	20.2	(76)
East	0.9x	0.77	x	1.72	x	63.27	x	0.63	x	0.7	=	33.26	(76)
East	0.9x	0.77	x	1.72	x	92.28	x	0.63	x	0.7	=	48.51	(76)
East	0.9x	0.77	x	1.72	x	113.09	x	0.63	x	0.7	=	59.45	(76)
East	0.9x	0.77	x	1.72	x	115.77	x	0.63	x	0.7	=	60.86	(76)
East	0.9x	0.77	x	1.72	x	110.22	x	0.63	x	0.7	=	57.94	(76)
East	0.9x	0.77	x	1.72	x	94.68	x	0.63	x	0.7	=	49.77	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	1.72	x	45.59	x	0.63	x	0.7	=	23.96	(76)
East	0.9x	0.77	x	1.72	x	24.49	x	0.63	x	0.7	=	12.87	(76)
East	0.9x	0.77	x	1.72	x	16.15	x	0.63	x	0.7	=	8.49	(76)
West	0.9x	0.77	x	1.72	x	19.64	x	0.63	x	0.7	=	20.65	(80)
West	0.9x	0.77	x	1.72	x	38.42	x	0.63	x	0.7	=	40.39	(80)
West	0.9x	0.77	x	1.72	x	63.27	x	0.63	x	0.7	=	66.52	(80)
West	0.9x	0.77	x	1.72	x	92.28	x	0.63	x	0.7	=	97.01	(80)
West	0.9x	0.77	x	1.72	x	113.09	x	0.63	x	0.7	=	118.9	(80)
West	0.9x	0.77	x	1.72	x	115.77	x	0.63	x	0.7	=	121.71	(80)
West	0.9x	0.77	x	1.72	x	110.22	x	0.63	x	0.7	=	115.87	(80)
West	0.9x	0.77	x	1.72	x	94.68	x	0.63	x	0.7	=	99.53	(80)
West	0.9x	0.77	x	1.72	x	73.59	x	0.63	x	0.7	=	77.37	(80)
West	0.9x	0.77	x	1.72	x	45.59	x	0.63	x	0.7	=	47.93	(80)
West	0.9x	0.77	x	1.72	x	24.49	x	0.63	x	0.7	=	25.75	(80)
West	0.9x	0.77	x	1.72	x	16.15	x	0.63	x	0.7	=	16.98	(80)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	74.06	142.94	239.71	370.29	481.12	506.7	476.43	389.39	284.29	169.92	91.78	61.39	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	435.86	504.54	590.26	700.47	791.47	796.47	751.31	669.67	573.32	479.2	426.05	413.87	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	1	0.98	0.92	0.76	0.55	0.41	0.48	0.77	0.97	1	1	(86)

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

(87)m=	19.84	20.01	20.3	20.68	20.92	20.99	21	21	20.94	20.59	20.15	19.81	(87)

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

(88)m=	20.1	20.1	20.1	20.11	20.12	20.13	20.13	20.13	20.12	20.12	20.11	20.11	(88)

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

(89)m=	1	0.99	0.98	0.9	0.71	0.48	0.33	0.39	0.7	0.96	0.99	1	(89)

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

(90)m=	18.73	18.95	19.33	19.8	20.05	20.12	20.13	20.13	20.08	19.7	19.14	18.71	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	19.12	19.32	19.67	20.11	20.36	20.43	20.43	20.43	20.38	20.01	19.49	19.09	(92)

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

(93)m=	19.12	19.32	19.67	20.11	20.36	20.43	20.43	20.43	20.38	20.01	19.49	19.09	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.9	0.73	0.51	0.36	0.42	0.72	0.95	0.99	1	(94)

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

(95)m=	434.35	500.41	574.97	631.42	574.8	402.84	267.11	279.81	414.69	457.08	422.78	412.79	(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=	1074.38	1042.19	948.65	795.21	612.49	406.68	267.51	280.77	440.81	665.95	882.04	1066.35	(97)

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

(97a)m=	476.18	364.08	278.02	117.93	28.04	0	0	0	0	155.4	330.67	486.25	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2236.58 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	476.18	364.08	278.02	117.93	28.04	0	0	0	0	155.4	330.67	486.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2236.58 (98)

Space heating requirement in kWh/m²/year 30.35 (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)

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Efficiency of main space heating system 1	90.4	(206)
Efficiency of secondary/supplementary heating system, %	0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	476.18	364.08	278.02	117.93	28.04	0	0	0	0	155.4	330.67	486.25	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	526.75	402.74	307.54	130.46	31.02	0	0	0	0	171.9	365.79	537.89	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2474.09 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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)	168.81	150.46	159.41	142.04	139.68	123.88	117.23	129.09	127.91	144.91	156.48	168.56

Efficiency of water heater	80.3	(216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(217)m=	87.52	87.19	86.44	84.59	81.83	80.3	80.3	80.3	80.3	85.23	86.89	87.56	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	192.89	172.56	184.42	167.92	170.69	154.27	146	160.77	159.29	170.02	180.09	192.5	

Total = Sum(219a)$_{1...12}$ = 2051.42 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2474.09
Water heating fuel used		2051.42
Electricity for pumps, fans and electric keep-hot		
central heating pump:	30	(230c)
boiler with a fan-assisted flue	45	(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75 (231)
Electricity for lighting		174.05 (232)
Electricity generated by PVs		-625.75 (233)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x		0.21	=	519.56	(261)
Space heating (secondary)	(215) x		0.136	=	0	(263)
Water heating	(219) x		0.21	=	430.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =				950.36	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.136	=	10.2	(267)
Electricity for lighting	(232) x		0.136	=	23.67	(268)

Energy saving/generation technologies

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Item 1	0.136	=	-85.1	(269)
Total CO2, kg/year	sum of (265)…(271) =		899.13	(272)
TER =			12.2	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 74 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7	(1a) x	2.5	(2a) =	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							1	x 10 =	10	(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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.05	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.2	(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) =	0.17	(21)

DER WorkSheet: New dwelling design stage

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												
	0.22	0.22	0.21	0.19	0.19	0.16	0.16	0.16	0.17	0.19	0.2	0.2

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)
(24d)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(24d)

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

(25)m=	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	(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			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 2			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 5			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Walls	75.43	25.68	49.75	x 0.15 =	7.46			(29)
Total area of elements, m²			75.43					(31)
Party wall			28.55	x 0 =	0			(32)
Party floor			73.7					(32a)
Party ceiling			73.7					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13283 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 2.73 (36)

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

Total fabric heat loss (33) + (36) = 39.59 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.89	31.83	31.78	31.51	31.46	31.23	31.23	31.19	31.32	31.46	31.56	31.67	(38)

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

(39)m=	71.48	71.43	71.37	71.1	71.05	70.82	70.82	70.78	70.91	71.05	71.15	71.26	

Average = Sum(39)$_{1...12}$ /12= 71.1 (39)

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

(40)m=	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.97	0.97	

Average = Sum(40)$_{1...12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.33 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

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

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.06	18.34	19.55	18.18	18.03	16.71	17.26	18.02	18.17	19.54	19.65	21.07	(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=	195.83	174.23	183.67	162.01	158.22	139.19	130.19	144.78	144.05	164.86	179.57	194.67	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-45.91	-40.4	-41.23	-33.94	-31.52	-26.01	-22.03	-26.67	-27.44	-33.91	-39.26	-44.37	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	149.91	133.83	142.44	128.06	126.7	113.17	108.17	118.12	116.61	130.95	140.32	150.3	

Output from water heater (annual)$_{1...12}$ 1558.59 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	63.38	56.42	59.46	52.37	51.12	44.9	41.87	46.65	46.4	53.2	58.09	62.99	(65)

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

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

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

(67)m=	6.49	5.76	4.69	3.55	2.65	2.24	2.42	3.14	4.22	5.36	6.25	6.67	(67)

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

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

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

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	85.18	83.96	79.92	72.73	68.71	62.36	56.27	62.71	64.44	71.51	80.68	84.66	(72)

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

(73)m=	358.43	358.61	348.12	328.34	308.97	288.61	273.62	278.65	286.84	306.5	331.02	349.01	(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)	
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	3.6	x	10.63	x	0.5	x	0.7	=	9.28	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	3.6	x	20.32	x	0.5	x	0.7	=	17.74	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	3.6	x	34.53	x	0.5	x	0.7	=	30.15	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	3.6	x	55.46	x	0.5	x	0.7	=	48.43	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	3.6	x	74.72	x	0.5	x	0.7	=	65.24	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	3.6	x	79.99	x	0.5	x	0.7	=	69.84	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	3.6	x	74.68	x	0.5	x	0.7	=	65.21	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	3.6	x	59.25	x	0.5	x	0.7	=	51.73	(74)

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North	0.9x	0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.5	x	0.7	=	36.25	(74)
North	0.9x	0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.5	x	0.7	=	21.12	(74)
North	0.9x	0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.5	x	0.7	=	11.45	(74)
North	0.9x	0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.5	x	0.7	=	7.74	(74)
East	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(76)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	13.72	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	26.84	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	44.2	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	64.46	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	79	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	80.87	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	76.99	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	66.14	(80)
West	0.9x	0.77	x	2.4	x	73.59	x	0.3	x	0.7	=	51.41	(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	31.85	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	17.11	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	11.28	(80)

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

(83)m=	68.24	131.34	221.07	345.3	453.4	479.83	450.21	364.76	263.2	156.19	84.46	56.66	(83)

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

(84)m=	426.67	489.96	569.19	673.64	762.37	768.44	723.83	643.41	550.04	462.69	415.48	405.67	(84)

7. Mean internal temperature (heating season)

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

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

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

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(86)m=	1	1	0.99	0.94	0.79	0.58	0.43	0.5	0.8	0.97	1	1	(86)

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

(87)m=	19.85	20	20.29	20.65	20.91	20.99	21	21	20.92	20.57	20.13	19.81	(87)

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

(88)m=	20.11	20.11	20.11	20.11	20.11	20.12	20.12	20.12	20.11	20.11	20.11	20.11	(88)

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

(89)m=	1	0.99	0.98	0.91	0.73	0.5	0.34	0.41	0.73	0.96	0.99	1	(89)

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

(90)m=	18.75	18.95	19.31	19.76	20.04	20.11	20.12	20.11	20.06	19.67	19.12	18.7	(90)

fLA = Living area ÷ (4) = 0.35 (91)

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

(92)m=	19.13	19.32	19.65	20.07	20.34	20.42	20.42	20.42	20.37	19.98	19.48	19.09	(92)

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

(93)m=	19.13	19.32	19.65	20.07	20.34	20.42	20.42	20.42	20.37	19.98	19.48	19.09	(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	0.91	0.75	0.53	0.37	0.44	0.75	0.96	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	425.34	486.42	556.34	615.28	569.87	406.75	270.29	283.36	412.06	444.13	412.64	404.71	(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=	1060.33	1030.04	938.77	794.54	614.07	411.9	270.85	284.75	444.27	666.64	880.65	1061.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	472.43	365.31	284.53	129.07	32.88	0	0	0	0	165.54	336.97	488.35	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2275.09 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	472.43	365.31	284.53	129.07	32.88	0	0	0	0	165.54	336.97	488.35	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2275.09 (98)

Space heating requirement in kWh/m²/year 30.87 (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)

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Efficiency of main space heating system 1 — 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	472.43	365.31	284.53	129.07	32.88	0	0	0	0	165.54	336.97	488.35	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	522.6	404.11	314.75	142.77	36.38	0	0	0	0	183.12	372.75	540.21	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2516.69 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater (calculated above)	149.91	133.83	142.44	128.06	126.7	113.17	108.17	118.12	116.61	130.95	140.32	150.3

Efficiency of water heater — 80.3 (216)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(217)m=	87.74	87.45	86.76	85.07	82.19	80.3	80.3	80.3	80.3	85.64	87.18	87.8

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	170.86	153.04	164.18	150.54	154.15	140.94	134.7	147.1	145.22	152.9	160.96	171.18

Total = Sum(219a)$_{1...12}$ = 1845.77 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2516.69
Water heating fuel used		1845.77
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		114.56 (232)
Electricity generated by PVs		-622.37 (233)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x		0.21	=	528.5	(261)
Space heating (secondary)	(215) x		0.136	=	0	(263)
Water heating	(219) x		0.21	=	387.61	(264)
Space and water heating	(261) + (262) + (263) + (264) =				916.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x		0.136	=	4.08	(267)
Electricity for lighting	(232) x		0.136	=	15.58	(268)
Energy saving/generation technologies Item 1			0.136	=	-84.64	(269)

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Total CO2, kg/year	sum of (265)…(271) =	851.13	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =	11.55	(273)
EI rating (section 14)		90	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 76 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.9	(1a) x	2.5	(2a) =	189.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		189.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (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)

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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												
	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.6	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	21.18	15.12	6.06	x 0.18 =	1.09			(29)
Roof	75.9	0	75.9	x 0.11 =	8.08			(30)
Total area of elements, m²			97.08					(31)
Party wall			74.58	x 0 =	0			(32)
Party floor			75.9					(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.49 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17507.1 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.14 (36)

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

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Total fabric heat loss (33) + (36) = 32.63 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.43	37.2	36.96	35.87	35.66	34.71	34.71	34.53	35.08	35.66	36.08	36.51	(38)

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

(39)m=	70.06	69.82	69.59	68.49	68.29	67.33	67.33	67.16	67.7	68.29	68.7	69.14	

Average = Sum(39)$_{1...12}$ /12= 68.49 (39)

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

(40)m=	0.92	0.92	0.92	0.9	0.9	0.89	0.89	0.88	0.89	0.9	0.91	0.91	

Average = Sum(40)$_{1...12}$ /12= 0.9 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	41.06	39.57	38.08	36.58	35.09	33.6	33.6	35.09	36.58	38.08	39.57	41.06	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 112.71 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.84	40.34	38.84	37.32	35.82	34.31	34.3	35.8	37.3	38.82	40.35	41.87	

Total = Sum(44)$_{1...12}$ = 456.9 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	177	157.88	166.22	145.66	141.99	124.04	114.37	128.38	127.49	147.17	161.96	175.81	

Total = Sum(45)$_{1...12}$ = 1767.97 (45)

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

(46)m=	26.55	23.68	24.93	21.85	21.3	18.61	17.16	19.26	19.12	22.08	24.29	26.37	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.32	18.57	19.79	18.41	18.25	16.92	17.48	18.24	18.4	19.78	19.9	21.34	(61)

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

(62)m=	198.32	176.45	186.01	164.07	160.24	140.96	131.85	146.63	145.88	166.95	181.86	197.15	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-27.48	-24.18	-24.68	-20.31	-18.87	-15.57	-13.18	-15.96	-16.42	-20.29	-23.5	-26.56	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	170.84	152.27	161.33	143.75	141.37	125.39	118.67	130.67	129.46	146.66	158.36	170.59	

Output from water heater (annual)$_{1...12}$ 1749.35 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	64.18	57.14	60.21	53.03	51.77	45.47	42.4	47.25	46.99	53.88	58.83	63.79	(65)

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

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=	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	(66)

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

(67)m=	10.16	9.03	7.34	5.56	4.15	3.51	3.79	4.93	6.61	8.4	9.8	10.45	(67)

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

(68)m=	210.66	212.85	207.34	195.61	180.81	166.89	157.6	155.41	160.92	172.65	187.45	201.36	(68)

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

(69)m=	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	(71)

Water heating gains (Table 5)

(72)m=	86.27	85.02	80.93	73.66	69.59	63.16	56.99	63.51	65.26	72.42	81.7	85.74	(72)

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

(73)m=	368.8	368.6	357.32	336.53	316.26	295.26	280.08	285.55	294.5	315.17	340.66	359.26	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.63	x	0.7	=	216.04	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.63	x	0.7	=	353.81	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.63	x	0.7	=	450.69	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.63	x	0.7	=	509.38	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.63	x	0.7	=	530.8	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.63	x	0.7	=	510.83	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.63	x	0.7	=	499.11	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.63	x	0.7	=	484.7	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.63	x	0.7	=	470.8	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.63	x	0.7	=	381.62	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.63	x	0.7	=	256.08	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.63	x	0.7	=	186.67	(78)

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

(83)m=	216.04	353.81	450.69	509.38	530.8	510.83	499.11	484.7	470.8	381.62	256.08	186.67	(83)

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

(84)m=	584.83	722.41	808.01	845.91	847.06	806.09	779.19	770.25	765.3	696.79	596.74	545.93	(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=	0.99	0.97	0.93	0.85	0.71	0.53	0.38	0.4	0.6	0.87	0.98	0.99	(86)

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

(87)m=	20.13	20.38	20.63	20.84	20.95	20.99	21	21	20.99	20.84	20.45	20.09	(87)

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

(88)m=	20.15	20.15	20.15	20.17	20.17	20.18	20.18	20.18	20.17	20.17	20.16	20.16	(88)

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

(89)m=	0.99	0.97	0.92	0.82	0.66	0.46	0.31	0.33	0.53	0.83	0.97	0.99	(89)

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

(90)m=	19.14	19.46	19.76	20.01	20.13	20.18	20.18	20.18	20.17	20.03	19.56	19.09	(90)

fLA = Living area ÷ (4) = 0.23 (91)

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

(92)m=	19.37	19.67	19.95	20.2	20.32	20.36	20.36	20.37	20.35	20.21	19.76	19.32	(92)

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

(93)m=	19.37	19.67	19.95	20.2	20.32	20.36	20.36	20.37	20.35	20.21	19.76	19.32	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.91	0.82	0.67	0.48	0.33	0.35	0.55	0.83	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	577.24	694.87	737.75	692.66	567.84	385.75	253.31	266.1	418.39	580.49	576.66	540.87	(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=	1055.6	1031.03	936.29	773.99	588.53	387.89	253.47	266.33	423.3	656.38	869.89	1045.31	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	355.9	225.9	147.72	58.56	15.4	0	0	0	0	56.46	211.12	375.31	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1446.37 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	355.9	225.9	147.72	58.56	15.4	0	0	0	0	56.46	211.12	375.31	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1446.37 (98)

Space heating requirement in kWh/m²/year 19.06 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	355.9	225.9	147.72	58.56	15.4	0	0	0	0	56.46	211.12	375.31	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	393.7	249.89	163.4	64.78	17.03	0	0	0	0	62.45	233.54	415.16	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1599.97 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	170.84	152.27	161.33	143.75	141.37	125.39	118.67	130.67	129.46	146.66	158.36	170.59

Efficiency of water heater 80.3 (216)

(217)m=	86.86	86.04	84.83	82.98	81.19	80.3	80.3	80.3	80.3	82.87	85.78	86.98

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.69	176.97	190.18	173.23	174.12	156.15	147.78	162.72	161.22	176.97	184.62	196.12

Total = Sum(219a)$_{1...12}$ = 2096.78 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1599.97	
Water heating fuel used		2096.78	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		179.51	(232)
Electricity generated by PVs		-642.21	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	335.99	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating	(219) x	0.21	=	440.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =			776.32	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	24.41	(268)
Energy saving/generation technologies Item 1		0.136	=	-87.34	(269)
Total CO2, kg/year	sum of (265)…(271) =			723.59	(272)

TER = 9.53 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 76 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.9	(1a) x	2.5	(2a) =	189.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		189.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.11	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.26	(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) =	0.22	(21)

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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												
	0.28	0.27	0.27	0.24	0.23	0.21	0.21	0.2	0.22	0.23	0.24	0.26

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

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

(25)m=	0.54	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	21.18	15.12	6.06	x 0.15 =	0.91			(29)
Roof	75.9	0	75.9	x 0.1 =	7.59			(30)
Total area of elements, m²			97.08					(31)
Party wall			74.58	x 0 =	0			(32)
Party floor			75.9					(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 25.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17507.1 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 8.69 (36)

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

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Total fabric heat loss (33) + (36) = 34.5 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	33.71	33.61	33.52	33.09	33.01	32.64	32.64	32.57	32.78	33.01	33.18	33.35	(38)

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

(39)m=	68.2	68.11	68.02	67.59	67.51	67.14	67.14	67.07	67.28	67.51	67.67	67.84	

Average = Sum(39)$_{1...12}$ /12= 67.59 (39)

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

(40)m=	0.9	0.9	0.9	0.89	0.89	0.88	0.88	0.88	0.89	0.89	0.89	0.89	

Average = Sum(40)$_{1...12}$ /12= 0.89 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA <= 13.9, N = 1

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	41.06	39.57	38.08	36.58	35.09	33.6	33.6	35.09	36.58	38.08	39.57	41.06	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 112.71 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.84	40.34	38.84	37.32	35.82	34.31	34.3	35.8	37.3	38.82	40.35	41.87	

Total = Sum(44)$_{1...12}$ = 456.9 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	177	157.88	166.22	145.66	141.99	124.04	114.37	128.38	127.49	147.17	161.96	175.81	

Total = Sum(45)$_{1...12}$ = 1767.97 (45)

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

(46)m=	26.55	23.68	24.93	21.85	21.3	18.61	17.16	19.26	19.12	22.08	24.29	26.37	(46)

Water storage loss:

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

If Heat network 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:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	21.32	18.57	19.79	18.41	18.25	16.92	17.48	18.24	18.4	19.78	19.9	21.34	(61)

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

(62)m=	198.32	176.45	186.01	164.07	160.24	140.96	131.85	146.63	145.88	166.95	181.86	197.15	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-49.31	-43.38	-44.28	-36.45	-33.85	-27.93	-23.65	-28.63	-29.46	-36.41	-42.16	-47.65	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	149.02	133.07	141.73	127.62	126.39	113.03	108.2	118	116.42	130.55	139.7	149.5	

Output from water heater (annual)$_{1...12}$ 1553.22 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	64.18	57.14	60.21	53.03	51.77	45.47	42.4	47.25	46.99	53.88	58.83	63.79	(65)

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

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=	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	(66)

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

(67)m=	6.69	5.94	4.83	3.66	2.73	2.31	2.49	3.24	4.35	5.53	6.45	6.87	(67)

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

(68)m=	210.66	212.85	207.34	195.61	180.81	166.89	157.6	155.41	160.92	172.65	187.45	201.36	(68)

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

(69)m=	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	(71)

Water heating gains (Table 5)

(72)m=	86.27	85.02	80.93	73.66	69.59	63.16	56.99	63.51	65.26	72.42	81.7	85.74	(72)

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

(73)m=	365.32	365.52	354.81	334.63	314.83	294.06	278.79	283.87	292.24	312.3	337.31	355.69	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	102.87	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	168.48	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	214.61	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	242.56	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	252.76	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	243.25	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	237.67	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	230.81	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	224.19	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	181.72	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	121.94	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	88.89	(78)

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

(83)m=	102.87	168.48	214.61	242.56	252.76	243.25	237.67	230.81	224.19	181.72	121.94	88.89	(83)

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

(84)m=	468.2	534	569.42	577.19	567.6	537.31	516.46	514.68	516.43	494.02	459.25	444.58	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.96	0.9	0.75	0.56	0.59	0.81	0.96	0.99	1	(86)

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

(87)m=	20.01	20.16	20.37	20.61	20.83	20.96	20.99	20.99	20.93	20.66	20.28	19.97	(87)

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

(88)m=	20.17	20.17	20.17	20.18	20.18	20.18	20.18	20.18	20.18	20.18	20.17	20.17	(88)

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

(89)m=	1	0.99	0.98	0.95	0.86	0.67	0.46	0.49	0.74	0.95	0.99	1	(89)

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

(90)m=	19	19.2	19.46	19.77	20.02	20.16	20.18	20.18	20.13	19.84	19.36	18.96	(90)

fLA = Living area ÷ (4) = 0.23 (91)

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

(92)m=	19.23	19.42	19.67	19.96	20.2	20.34	20.36	20.36	20.31	20.03	19.57	19.19	(92)

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

(93)m=	19.23	19.42	19.67	19.96	20.2	20.34	20.36	20.36	20.31	20.03	19.57	19.19	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.87	0.69	0.49	0.51	0.76	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	466.06	528.41	556.22	545.85	491.58	370.19	251.16	263.69	390.76	466.63	454.35	443.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1018.12	988.86	895.83	747.55	574.12	385.26	252.66	265.78	418.08	636.29	843.72	1016.66	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	410.73	309.42	252.67	145.22	61.41	0	0	0	0	126.23	280.35	426.75	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2012.78 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	410.73	309.42	252.67	145.22	61.41	0	0	0	0	126.23	280.35	426.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2012.78 (98)

Space heating requirement in kWh/m²/year 26.52 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	410.73	309.42	252.67	145.22	61.41	0	0	0	0	126.23	280.35	426.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	454.35	342.28	279.5	160.64	67.93	0	0	0	0	139.64	310.12	472.07	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2226.53 (211)

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

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

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

Water heating

Output from water heater (calculated above)

	149.02	133.07	141.73	127.62	126.39	113.03	108.2	118	116.42	130.55	139.7	149.5

Efficiency of water heater 80.3 (216)

(217)m=	87.47	87.11	86.49	85.38	83.34	80.3	80.3	80.3	80.3	84.97	86.77	87.54

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	170.36	152.77	163.87	149.48	151.65	140.76	134.75	146.94	144.99	153.65	161	170.77

Total = Sum(219a)$_{1...12}$ = 1840.97 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2226.53	
Water heating fuel used		1840.97	
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		118.13	(232)
Electricity generated by PVs		-640.95	(233)

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	467.57	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	386.6	(264)
Space and water heating	(261) + (262) + (263) + (264) =			854.17	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.136	=	4.08	(267)
Electricity for lighting	(232) x	0.136	=	16.07	(268)
Energy saving/generation technologies Item 1		0.136	=	-87.17	(269)
Total CO2, kg/year	sum of (265)…(271) =			787.15	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			10.37	(273)
EI rating (section 14)				91	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 84 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9 (1a)	x	2.5 (2a)	=	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

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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												
	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Floor			83.9	x 0.13 =	10.907			(28)
Walls	55.6	13.44	42.16	x 0.18 =	7.59			(29)
Total area of elements, m²			139.5					(31)
Party wall			77.58	x 0 =	0			(32)
Party ceiling			83.9					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.89 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 25303.5 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 13.73 (36)

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

Total fabric heat loss (33) + (36) = — 47.62 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.89	40.64	40.4	39.28	39.07	38.09	38.09	37.91	38.47	39.07	39.5	39.94	(38)

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

(39)m=	88.5	88.26	88.02	86.9	86.69	85.71	85.71	85.53	86.09	86.69	87.11	87.56	

Average = Sum(39)$_{1...12}$ /12= 86.9 (39)

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

(40)m=	1.05	1.05	1.05	1.04	1.03	1.02	1.02	1.02	1.03	1.03	1.04	1.04	

Average = Sum(40)$_{1...12}$ /12= 1.04 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.53 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

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

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.16	19.3	20.57	19.13	18.97	17.58	18.16	18.96	19.12	20.56	20.68	22.17	(61)

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

(62)m=	206.23	183.48	193.43	170.61	166.63	146.58	137.11	152.47	151.7	173.61	189.11	205.01	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-28.97	-25.49	-26.02	-21.41	-19.88	-16.4	-13.89	-16.81	-17.3	-21.38	-24.77	-28	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	177.26	157.99	167.41	149.2	146.75	130.17	123.22	135.66	134.4	152.23	164.35	177.01	

Output from water heater (annual)$_{1...12}$ 1815.65 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	66.74	59.42	62.62	55.15	53.84	47.29	44.09	49.13	48.86	56.03	61.17	66.34	(65)

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

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

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

(67)m=	11.36	10.09	8.21	6.21	4.64	3.92	4.24	5.51	7.39	9.38	10.95	11.68	(67)

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

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

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

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	89.71	88.42	84.16	76.6	72.36	65.68	59.26	66.04	67.87	75.31	84.96	89.16	(72)

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

(73)m=	392.46	392.26	380.17	357.95	336.17	313.74	297.61	303.3	312.95	335.05	362.25	382.19	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.63	x	0.7	=	72.01	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.63	x	0.7	=	51.44	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.63	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.63	x	0.7	=	117.94	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.63	x	0.7	=	84.24	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.63	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.63	x	0.7	=	150.23	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.63	x	0.7	=	107.31	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.63	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.63	x	0.7	=	169.79	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.63	x	0.7	=	121.28	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.63	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.63	x	0.7	=	176.93	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.63	x	0.7	=	126.38	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.63	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.63	x	0.7	=	170.28	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.63	x	0.7	=	121.63	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.63	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.63	x	0.7	=	166.37	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.63	x	0.7	=	118.84	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.63	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.63	x	0.7	=	161.57	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.63	x	0.7	=	115.41	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.63	x	0.7	=	76.94	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.63	x	0.7	=	156.93		(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.63	x	0.7	=	112.1		(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.63	x	0.7	=	74.73		(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.63	x	0.7	=	127.21		(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.63	x	0.7	=	90.86		(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.63	x	0.7	=	60.57		(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.63	x	0.7	=	85.36		(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.63	x	0.7	=	60.97		(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.63	x	0.7	=	40.65		(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.63	x	0.7	=	62.22		(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.63	x	0.7	=	44.45		(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.63	x	0.7	=	29.63		(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.63	x	0.7	=	14.41		(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.63	x	0.7	=	28.18		(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.63	x	0.7	=	46.41		(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.63	x	0.7	=	67.68		(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.63	x	0.7	=	82.95		(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.63	x	0.7	=	84.91		(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.63	x	0.7	=	80.84		(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.63	x	0.7	=	69.44		(80)
West	0.9x		x		x		x		x		=			(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.63	x	0.7	=	33.44		(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.63	x	0.7	=	17.96		(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.63	x	0.7	=	11.85		(80)

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

(83)m=	172.15	286.52	375.49	439.61	470.52	457.9	445.27	423.35	397.73	312.08	204.94	148.15	(83)

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

(84)m=	564.6	678.77	755.66	797.56	806.69	771.64	742.88	726.65	710.69	647.13	567.19	530.34	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.94	0.85	0.68	0.5	0.53	0.76	0.95	0.99	1	(86)

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

(87)m=	19.81	20.03	20.3	20.6	20.84	20.96	20.99	20.99	20.93	20.62	20.15	19.77	(87)

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

(88)m=	20.04	20.04	20.04	20.05	20.06	20.07	20.07	20.07	20.06	20.06	20.05	20.05	(88)

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

(89)m=	1	0.99	0.97	0.91	0.8	0.59	0.4	0.43	0.68	0.93	0.99	1	(89)

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

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(90)m=	18.65	18.93	19.27	19.65	19.92	20.05	20.06	20.06	20.02	19.69	19.1	18.61	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	18.87	19.14	19.47	19.83	20.09	20.22	20.24	20.24	20.19	19.86	19.3	18.83	(92)

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

(93)m=	18.87	19.14	19.47	19.83	20.09	20.22	20.24	20.24	20.19	19.86	19.3	18.83	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.91	0.8	0.61	0.42	0.45	0.7	0.92	0.98	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	560.88	667.33	726.16	725	644.5	467.65	310.48	326.22	494.44	596.04	558.46	527.76	(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=	1289.61	1256.49	1141.35	950.03	727.6	481.64	311.98	328.45	524.26	803.13	1062.87	1281.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	542.17	395.91	308.9	162.02	61.82	0	0	0	0	154.07	363.18	560.47	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2548.55 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	542.17	395.91	308.9	162.02	61.82	0	0	0	0	154.07	363.18	560.47	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2548.55 (98)

Space heating requirement in kWh/m²/year 30.38 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	542.17	395.91	308.9	162.02	61.82	0	0	0	0	154.07	363.18	560.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	599.75	437.96	341.7	179.22	68.39	0	0	0	0	170.44	401.74	619.99	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2819.19 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

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Water heating

Output from water heater (calculated above)

	177.26	157.99	167.41	149.2	146.75	130.17	123.22	135.66	134.4	152.23	164.35	177.01

Efficiency of water heater 80.3 (216)

(217)m= 87.68 | 87.27 | 86.57 | 85.26 | 83.05 | 80.3 | 80.3 | 80.3 | 80.3 | 85.08 | 86.99 | 87.75 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 202.16 | 181.04 | 193.38 | 175 | 176.69 | 162.11 | 153.45 | 168.94 | 167.37 | 178.92 | 188.92 | 201.72

Total = Sum(219a)$_{1...12}$ = 2149.71 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2819.19	
Water heating fuel used		2149.71	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		200.61	(232)
Electricity generated by PVs		-708.08	(233)

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

	Energy kWh/year	**Emission factor**		**Emissions**	
Space heating (main system 1)		0.21	=	592.03	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	451.44	(264)
Space and water heating				1043.47	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	27.28	(268)
Energy saving/generation technologies					
Item 1		0.136	=	-96.3	(269)
Total CO2, kg/year sum of (265)…(271) =				984.65	(272)

TER = 11.74 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 84 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9	(1a) x	2.5	(2a) =	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.25	(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) =	0.21	(21)

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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												
	0.27	0.26	0.26	0.23	0.22	0.2	0.2	0.19	0.21	0.22	0.23	0.25

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.54	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(24d)

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

(25)m=	0.54	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Floor			83.9	x 0.11 =	9.229			(28)
Walls	55.6	13.44	42.16	x 0.15 =	6.32			(29)
Total area of elements, m²			139.5					(31)
Party wall			77.58	x 0 =	0			(32)
Party ceiling			83.9					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.94 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 25303.5 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 10.82 (36)

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

Total fabric heat loss (33) + (36) = 41.76 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.06	36.96	36.87	36.43	36.35	35.97	35.97	35.9	36.11	36.35	36.51	36.69	(38)

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

(39)m=	78.82	78.72	78.63	78.19	78.11	77.73	77.73	77.66	77.88	78.11	78.28	78.45	

Average = Sum(39)$_{1...12}$ /12= 78.19 (39)

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

(40)m=	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.94	

Average = Sum(40)$_{1...12}$ /12= 0.93 (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 — 2.53 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

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

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.16	19.3	20.57	19.13	18.97	17.58	18.16	18.96	19.12	20.56	20.68	22.17	(61)

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

(62)m=	206.23	183.48	193.43	170.61	166.63	146.58	137.11	152.47	151.7	173.61	189.11	205.01	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-51.98	-45.73	-46.67	-38.41	-35.67	-29.43	-24.91	-30.16	-31.04	-38.36	-44.43	-50.23	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	154.26	137.75	146.75	132.2	130.96	117.15	112.19	122.31	120.66	135.25	144.68	154.78	

Output from water heater (annual)$_{1...12}$ 1608.95 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	66.74	59.42	62.62	55.15	53.84	47.29	44.09	49.13	48.86	56.03	61.17	66.34	(65)

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

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

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

(67)m=	7.47	6.63	5.4	4.08	3.05	2.58	2.79	3.62	4.86	6.17	7.2	7.68	(67)

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

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

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

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	89.71	88.42	84.16	76.6	72.36	65.68	59.26	66.04	67.87	75.31	84.96	89.16	(72)

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

(73)m=	388.57	388.8	377.36	355.82	334.58	312.4	296.16	301.41	310.42	331.84	358.5	378.2	(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)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.3	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.3	x	0.7	=	24.49	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.3	x	0.7	=	16.33	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.3	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.3	x	0.7	=	40.11	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.3	x	0.7	=	26.74	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.3	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.3	x	0.7	=	51.1	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.3	x	0.7	=	34.07	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.3	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.3	x	0.7	=	57.75	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.3	x	0.7	=	38.5	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.3	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.3	x	0.7	=	60.18	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.3	x	0.7	=	40.12	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.3	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.3	x	0.7	=	57.92	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.3	x	0.7	=	38.61	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.3	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.3	x	0.7	=	56.59	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.3	x	0.7	=	37.73	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.3	x	0.7	=	76.94	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.3	x	0.7	=	54.96	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.3	x	0.7	=	36.64	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.3	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.3	x	0.7	=	53.38	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.3	x	0.7	=	35.59	(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.3	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.3	x	0.7	=	43.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.3	x	0.7	=	28.84	(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.3	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.3	x	0.7	=	29.03	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.3	x	0.7	=	19.36	(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.3	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.3	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.3	x	0.7	=	14.11	(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(80)

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

(83)m=	81.97	136.44	178.8	209.34	224.06	218.05	212.03	201.6	189.4	148.61	97.59	70.55

(83)

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

(84)m=	470.54	525.24	556.16	565.16	558.64	530.44	508.19	503.01	499.82	480.45	456.09	448.74

(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	0.98	0.94	0.83	0.65	0.68	0.89	0.98	1	1

(86)

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

(87)m=	19.88	20.01	20.22	20.48	20.73	20.92	20.99	20.98	20.87	20.55	20.16	19.84

(87)

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

(88)m=	20.13	20.14	20.14	20.14	20.14	20.15	20.15	20.15	20.14	20.14	20.14	20.14

(88)

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

(89)m=	1	1	0.99	0.97	0.92	0.76	0.54	0.57	0.83	0.97	1	1

(89)

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

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(90)m=	18.81	18.98	19.25	19.58	19.89	20.09	20.14	20.14	20.05	19.67	19.17	18.77	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	19.01	19.18	19.43	19.75	20.05	20.25	20.3	20.3	20.2	19.83	19.36	18.97	(92)

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

(93)m=	19.01	19.18	19.43	19.75	20.05	20.25	20.3	20.3	20.2	19.83	19.36	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=	1	0.99	0.99	0.97	0.91	0.77	0.56	0.59	0.83	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	469.21	522.16	549.06	547.4	510.52	405.97	283.4	296.79	417.14	465.39	453.24	447.77	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1159.37	1123.92	1016.73	848.34	652.23	439.2	287.58	302.67	475.41	721.23	959.58	1158.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	513.48	404.38	347.95	216.67	105.44	0	0	0	0	190.35	364.57	529.08	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2671.91 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	513.48	404.38	347.95	216.67	105.44	0	0	0	0	190.35	364.57	529.08	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2671.91 (98)

Space heating requirement in kWh/m²/year 31.85 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	513.48	404.38	347.95	216.67	105.44	0	0	0	0	190.35	364.57	529.08	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	568.01	447.32	384.9	239.68	116.63	0	0	0	0	210.56	403.28	585.26	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2955.66 (211)

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

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

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

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	154.26	137.75	146.75	132.2	130.96	117.15	112.19	122.31	120.66	135.25	144.68	154.78

Efficiency of water heater 80.3 (216)

(217)m= 87.85 | 87.6 | 87.15 | 86.29 | 84.51 | 80.3 | 80.3 | 80.3 | 80.3 | 85.91 | 87.28 | 87.9 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 175.59 | 157.25 | 168.39 | 153.21 | 154.96 | 145.89 | 139.72 | 152.32 | 150.26 | 157.43 | 165.77 | 176.09

Total = Sum(219a)$_{1...12}$ = 1896.88 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2955.66	
Water heating fuel used		1896.88	
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		131.91	(232)
Electricity generated by PVs		-708.5	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	620.69	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	398.35	(264)
Space and water heating				1019.03	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	4.08	(267)
Electricity for lighting		0.136	=	17.94	(268)
Energy saving/generation technologies Item 1		0.136	=	-96.36	(269)
Total CO2, kg/year		sum of (265)…(271) =		944.7	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		11.26	(273)
EI rating (section 14)				90	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 84 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9	(1a) x	2.5	(2a) =	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

TER WorkSheet: New dwelling design stage

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												
	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.33	0.36	0.38	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.56	0.56	0.57	0.58	(24d)

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Walls	55.6	13.44	42.16	x 0.18 =	7.59			(29)
Total area of elements, m²			55.6					(31)
Party wall			77.58	x 0 =	0			(32)
Party floor			83.9					(32a)
Party ceiling			83.9					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 22.98 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22367 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 3.21 (36)

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

Total fabric heat loss (33) + (36) = 26.18 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	40.89	40.64	40.4	39.28	39.07	38.09	38.09	37.91	38.47	39.07	39.5	39.94	(38)

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

(39)m=	67.07	66.83	66.59	65.47	65.26	64.28	64.28	64.1	64.66	65.26	65.68	66.13	

Average = Sum(39)$_{1...12}$ /12= 65.47 (39)

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

(40)m=	0.8	0.8	0.79	0.78	0.78	0.77	0.77	0.76	0.77	0.78	0.78	0.79	

Average = Sum(40)$_{1...12}$ /12= 0.78 (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 — 2.53 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

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

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.16	19.3	20.57	19.13	18.97	17.58	18.16	18.96	19.12	20.56	20.68	22.17	(61)

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

(62)m=	206.23	183.48	193.43	170.61	166.63	146.58	137.11	152.47	151.7	173.61	189.11	205.01	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-28.97	-25.49	-26.02	-21.41	-19.88	-16.4	-13.89	-16.81	-17.3	-21.38	-24.77	-28	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	177.26	157.99	167.41	149.2	146.75	130.17	123.22	135.66	134.4	152.23	164.35	177.01	

Output from water heater (annual)$_{1...12}$ 1815.65 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	66.74	59.42	62.62	55.15	53.84	47.29	44.09	49.13	48.86	56.03	61.17	66.34	(65)

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

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

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

(67)m=	11.36	10.09	8.21	6.21	4.64	3.92	4.24	5.51	7.39	9.38	10.95	11.68	(67)

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

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

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

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	89.71	88.42	84.16	76.6	72.36	65.68	59.26	66.04	67.87	75.31	84.96	89.16	(72)

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

(73)m=	392.46	392.26	380.17	357.95	336.17	313.74	297.61	303.3	312.95	335.05	362.25	382.19	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.63	x	0.7	=	72.01	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.63	x	0.7	=	51.44	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.63	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.63	x	0.7	=	117.94	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.63	x	0.7	=	84.24	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.63	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.63	x	0.7	=	150.23	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.63	x	0.7	=	107.31	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.63	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.63	x	0.7	=	169.79	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.63	x	0.7	=	121.28	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.63	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.63	x	0.7	=	176.93	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.63	x	0.7	=	126.38	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.63	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.63	x	0.7	=	170.28	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.63	x	0.7	=	121.63	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.63	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.63	x	0.7	=	166.37	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.63	x	0.7	=	118.84	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.63	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.63	x	0.7	=	161.57	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.63	x	0.7	=	115.41	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.63	x	0.7	=	76.94	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.63	x	0.7	=	156.93		(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.63	x	0.7	=	112.1		(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.63	x	0.7	=	74.73		(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.63	x	0.7	=	127.21		(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.63	x	0.7	=	90.86		(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.63	x	0.7	=	60.57		(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.63	x	0.7	=	85.36		(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.63	x	0.7	=	60.97		(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.63	x	0.7	=	40.65		(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.63	x	0.7	=	62.22		(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.63	x	0.7	=	44.45		(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.63	x	0.7	=	29.63		(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.63	x	0.7	=	14.41		(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.63	x	0.7	=	28.18		(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.63	x	0.7	=	46.41		(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.63	x	0.7	=	67.68		(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.63	x	0.7	=	82.95		(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.63	x	0.7	=	84.91		(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.63	x	0.7	=	80.84		(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.63	x	0.7	=	69.44		(80)
West	0.9x		x		x		x		x		=			(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.63	x	0.7	=	33.44		(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.63	x	0.7	=	17.96		(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.63	x	0.7	=	11.85		(80)

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

(83)m=	172.15	286.52	375.49	439.61	470.52	457.9	445.27	423.35	397.73	312.08	204.94	148.15	(83)

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

(84)m=	564.6	678.77	755.66	797.56	806.69	771.64	742.88	726.65	710.69	647.13	567.19	530.34	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.98	0.95	0.87	0.72	0.53	0.38	0.41	0.62	0.89	0.99	1	(86)

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

(87)m=	20.24	20.44	20.66	20.87	20.97	21	21	21	20.99	20.86	20.52	20.2	(87)

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

(88)m=	20.25	20.26	20.26	20.27	20.27	20.28	20.28	20.28	20.28	20.27	20.27	20.26	(88)

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

(89)m=	0.99	0.98	0.94	0.84	0.68	0.47	0.32	0.34	0.56	0.86	0.98	1	(89)

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

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(90)m=	19.36	19.62	19.9	20.14	20.25	20.28	20.28	20.28	20.27	20.14	19.73	19.33	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	19.53	19.78	20.04	20.28	20.38	20.42	20.42	20.42	20.41	20.28	19.88	19.49	(92)

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

(93)m=	19.53	19.78	20.04	20.28	20.38	20.42	20.42	20.42	20.41	20.28	19.88	19.49	(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	0.68	0.48	0.33	0.35	0.57	0.86	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	560.05	661.93	706.85	671.73	551.3	372.72	245.39	257.57	404.34	558.79	554.36	527.34	(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=	1021.41	994.26	901.81	744.98	566.7	373.89	245.46	257.68	407.94	631.75	839.12	1011.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	343.25	223.33	145.04	52.74	11.46	0	0	0	0	54.28	205.03	360.02	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1395.16 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	343.25	223.33	145.04	52.74	11.46	0	0	0	0	54.28	205.03	360.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1395.16 (98)

Space heating requirement in kWh/m²/year 16.63 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	343.25	223.33	145.04	52.74	11.46	0	0	0	0	54.28	205.03	360.02	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	379.7	247.05	160.45	58.34	12.68	0	0	0	0	60.05	226.8	398.25	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1543.32 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

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Water heating

Output from water heater (calculated above)

	177.26	157.99	167.41	149.2	146.75	130.17	123.22	135.66	134.4	152.23	164.35	177.01

Efficiency of water heater 80.3 (216)

(217)m= 86.69 | 85.92 | 84.69 | 82.71 | 80.96 | 80.3 | 80.3 | 80.3 | 80.3 | 82.73 | 85.61 | 86.8 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 204.48 | 183.88 | 197.67 | 180.38 | 181.27 | 162.11 | 153.45 | 168.94 | 167.37 | 184.01 | 191.97 | 203.93

Total = Sum(219a)$_{1...12}$ = 2179.46 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1543.32	
Water heating fuel used		2179.46	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		200.61	(232)
Electricity generated by PVs		-708.08	(233)

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

	Energy kWh/year	**Emission factor**		**Emissions**	
Space heating (main system 1)		0.21	=	324.1	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	457.69	(264)
Space and water heating				781.78	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	27.28	(268)
Energy saving/generation technologies					
Item 1		0.136	=	-96.3	(269)
Total CO2, kg/year	sum of (265)…(271) =			722.97	(272)

TER = 8.62 (273)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 84 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9	(1a) x	2.5	(2a) =	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.1	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.25	(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) =	0.21	(21)

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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												
	0.27	0.26	0.26	0.23	0.22	0.2	0.2	0.19	0.21	0.22	0.23	0.25

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.54	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(24d)

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

(25)m=	0.54	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.53	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Walls	55.6	13.44	42.16	x 0.15 =	6.32			(29)
Total area of elements, m²			55.6					(31)
Party wall			77.58	x 0 =	0			(32)
Party floor			83.9					(32a)
Party ceiling			83.9					(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 21.71 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22367 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 1.86 (36)

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

Total fabric heat loss (33) + (36) = — 23.57 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	37.06	36.96	36.87	36.43	36.35	35.97	35.97	35.9	36.11	36.35	36.51	36.69	(38)

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

(39)m=	60.63	60.53	60.44	60	59.92	59.54	59.54	59.47	59.69	59.92	60.09	60.26	

Average = Sum(39)$_{1...12}$ /12= 60 (39)

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

(40)m=	0.72	0.72	0.72	0.72	0.71	0.71	0.71	0.71	0.71	0.71	0.72	0.72	

Average = Sum(40)$_{1...12}$ /12= 0.72 (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 — 2.53 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

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

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.16	19.3	20.57	19.13	18.97	17.58	18.16	18.96	19.12	20.56	20.68	22.17	(61)

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

(62)m=	206.23	183.48	193.43	170.61	166.63	146.58	137.11	152.47	151.7	173.61	189.11	205.01	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-51.98	-45.73	-46.67	-38.41	-35.67	-29.43	-24.91	-30.16	-31.04	-38.36	-44.43	-50.23	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	154.26	137.75	146.75	132.2	130.96	117.15	112.19	122.31	120.66	135.25	144.68	154.78	

Output from water heater (annual)$_{1...12}$ 1608.95 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	66.74	59.42	62.62	55.15	53.84	47.29	44.09	49.13	48.86	56.03	61.17	66.34	(65)

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

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

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

(67)m=	7.47	6.63	5.4	4.08	3.05	2.58	2.79	3.62	4.86	6.17	7.2	7.68	(67)

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

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

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

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	89.71	88.42	84.16	76.6	72.36	65.68	59.26	66.04	67.87	75.31	84.96	89.16	(72)

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

(73)m=	388.57	388.8	377.36	355.82	334.58	312.4	296.16	301.41	310.42	331.84	358.5	378.2	(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)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.3	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.3	x	0.7	=	24.49	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.3	x	0.7	=	16.33	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.3	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.3	x	0.7	=	40.11	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.3	x	0.7	=	26.74	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.3	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.3	x	0.7	=	51.1	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.3	x	0.7	=	34.07	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.3	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.3	x	0.7	=	57.75	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.3	x	0.7	=	38.5	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.3	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.3	x	0.7	=	60.18	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.3	x	0.7	=	40.12	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.3	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.3	x	0.7	=	57.92	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.3	x	0.7	=	38.61	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.3	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.3	x	0.7	=	56.59	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.3	x	0.7	=	37.73	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.3	x	0.7	=	76.94	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.3	x	0.7	=	54.96	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.3	x	0.7	=	36.64	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.3	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.3	x	0.7	=	53.38	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.3	x	0.7	=	35.59	(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.3	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.3	x	0.7	=	43.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.3	x	0.7	=	28.84	(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.3	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.3	x	0.7	=	29.03	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.3	x	0.7	=	19.36	(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.3	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.3	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.3	x	0.7	=	14.11	(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(80)

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

(83)m=	81.97	136.44	178.8	209.34	224.06	218.05	212.03	201.6	189.4	148.61	97.59	70.55

(83)

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

(84)m=	470.54	525.24	556.16	565.16	558.64	530.44	508.19	503.01	499.82	480.45	456.09	448.74

(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	0.88	0.7	0.51	0.54	0.78	0.96	1	1

(86)

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

(87)m=	20.25	20.37	20.55	20.75	20.91	20.99	21	21	20.97	20.78	20.47	20.22

(87)

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

(88)m=	20.32	20.32	20.32	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.33	20.32

(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	0.63	0.44	0.46	0.72	0.95	0.99	1

(89)

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

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(90)m=	19.43	19.59	19.81	20.06	20.25	20.32	20.33	20.33	20.31	20.1	19.72	19.39	(90)

fLA = Living area ÷ (4) = 0.19 (91)

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

(92)m=	19.58	19.74	19.95	20.19	20.37	20.45	20.46	20.46	20.44	20.23	19.86	19.55	(92)

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

(93)m=	19.58	19.74	19.95	20.19	20.37	20.45	20.46	20.46	20.44	20.23	19.86	19.55	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.95	0.85	0.65	0.45	0.48	0.73	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	469.01	521.12	545.23	534.36	473.68	343.11	229.4	240.86	365.66	454.55	452.22	447.68	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	926.64	898.24	812.87	677.5	519.75	348.3	229.72	241.36	378.17	577.04	766.76	924.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	340.48	253.43	199.13	103.06	34.27	0	0	0	0	91.13	226.47	355.08	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1603.05 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	340.48	253.43	199.13	103.06	34.27	0	0	0	0	91.13	226.47	355.08	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1603.05 (98)

Space heating requirement in kWh/m²/year 19.11 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	340.48	253.43	199.13	103.06	34.27	0	0	0	0	91.13	226.47	355.08	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	376.64	280.34	220.27	114	37.91	0	0	0	0	100.81	250.52	392.79	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1773.28 (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)

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Water heating

Output from water heater (calculated above)

	154.26	137.75	146.75	132.2	130.96	117.15	112.19	122.31	120.66	135.25	144.68	154.78

Efficiency of water heater 80.3 (216)

(217)m= 86.99 | 86.57 | 85.82 | 84.43 | 82.21 | 80.3 | 80.3 | 80.3 | 80.3 | 84.08 | 86.17 | 87.08 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m= 177.33 | 159.13 | 171 | 156.57 | 159.31 | 145.89 | 139.72 | 152.32 | 150.26 | 160.85 | 167.89 | 177.75

Total = Sum(219a)$_{1...12}$ = 1918.03 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1773.28	
Water heating fuel used		1918.03	
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		131.91	(232)
Electricity generated by PVs		-708.5	(233)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	372.39	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	402.79	(264)
Space and water heating				775.18	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	4.08	(267)
Electricity for lighting		0.136	=	17.94	(268)
Energy saving/generation technologies Item 1		0.136	=	-96.36	(269)
Total CO2, kg/year	sum of (265)…(271) =			700.84	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			8.35	(273)
EI rating (section 14)				93	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 87 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	87.3	(1a) x	2.5	(2a) =	218.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	87.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		218.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.14	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.39	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.33	(21)

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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												
	0.42	0.41	0.4	0.36	0.35	0.31	0.31	0.3	0.33	0.35	0.37	0.39

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.59	0.58	0.58	0.57	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	0.57	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			1.2	x1/[1/(1.2)+ 0.04] =	1.37			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	48.67	19.68	28.99	x 0.18 =	5.22			(29)
Roof	87.3	0	87.3	x 0.11 =	9.3			(30)
Total area of elements, m²			135.98					(31)
Party wall			57.4	x 0 =	0			(32)
Party floor			87.3					(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 37.05 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16349.4 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 7.92 (36)

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

Total fabric heat loss (33) + (36) = 44.97 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	42.36	42.11	41.87	40.74	40.53	39.54	39.54	39.35	39.92	40.53	40.95	41.4	(38)

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

(39)m=	87.33	87.08	86.84	85.7	85.49	84.5	84.5	84.32	84.88	85.49	85.92	86.37	

Average = Sum(39)$_{1...12}$ /12= 85.7 (39)

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

(40)m=	1	1	0.99	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.98	0.99	

Average = Sum(40)$_{1...12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.59 (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

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

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	43.29	41.71	40.14	38.56	36.99	35.42	35.42	36.99	38.56	40.14	41.71	43.29	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 118.82 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	44.06	42.48	40.9	39.31	37.72	36.13	36.12	37.7	39.29	40.88	42.49	44.09	

Total = Sum(44)$_{1...12}$ = 481.18 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	186.59	166.44	175.23	153.56	149.68	130.76	120.57	135.34	134.4	155.15	170.74	185.34	

Total = Sum(45)$_{1...12}$ = 1863.8 (45)

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

(46)m=	27.99	24.97	26.28	23.03	22.45	19.61	18.09	20.3	20.16	23.27	25.61	27.8	(46)

Water storage loss:

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

If Heat network and no tank in dwelling, enter 110 litres in (47)

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

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

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.45	19.55	20.84	19.38	19.22	17.82	18.41	19.21	19.37	20.83	20.95	22.47	(61)

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

(62)m=	209.05	185.99	196.07	172.94	168.9	148.58	138.98	154.55	153.77	175.98	191.7	207.81	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-29.5	-25.96	-26.49	-21.8	-20.24	-16.7	-14.14	-17.11	-17.61	-21.77	-25.22	-28.51	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

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

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

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

Output from water heater

(64)m=	179.55	160.03	169.58	151.14	148.66	131.88	124.84	137.44	136.16	154.21	166.48	179.3	

Output from water heater (annual)$_{1...12}$ 1839.26 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	67.66	60.23	63.47	55.9	54.57	47.93	44.69	49.8	49.53	56.8	62.01	67.24	(65)

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

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=	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	(66)

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

(67)m=	11.21	9.95	8.09	6.13	4.58	3.87	4.18	5.43	7.29	9.26	10.8	11.52	(67)

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

(68)m=	234.02	236.45	230.33	217.3	200.86	185.4	175.08	172.65	178.77	191.79	208.24	223.7	(68)

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

(69)m=	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(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=	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	(71)

Water heating gains (Table 5)

(72)m=	90.94	89.63	85.31	77.64	73.35	66.57	60.07	66.94	68.79	76.34	86.13	90.38	(72)

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

(73)m=	400.97	400.83	388.54	365.88	343.6	320.65	304.13	309.82	319.65	342.19	369.97	390.4	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x 0.77	x	2.4	x	10.63	x	0.63	x	0.7	=	15.6	(74)
North	0.9x 0.77	x	5.04	x	10.63	x	0.63	x	0.7	=	32.76	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.63	x	0.7	=	29.81	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.63	x	0.7	=	62.6	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.63	x	0.7	=	50.65	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.63	x	0.7	=	106.37	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.63	x	0.7	=	81.36	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.63	x	0.7	=	170.86	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.63	x	0.7	=	109.6	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.63	x	0.7	=	230.17	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.63	x	0.7	=	117.33	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.63	x	0.7	=	246.4	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.63	x	0.7	=	109.55	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.63	x	0.7	=	230.05	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.63	x	0.7	=	86.91	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.63	x	0.7	=	182.51	(74)
North	0.9x 0.77	x	2.4	x	41.52	x	0.63	x	0.7	=	60.9	(74)
North	0.9x 0.77	x	5.04	x	41.52	x	0.63	x	0.7	=	127.9	(74)
North	0.9x 0.77	x	2.4	x	24.19	x	0.63	x	0.7	=	35.48	(74)
North	0.9x 0.77	x	5.04	x	24.19	x	0.63	x	0.7	=	74.52	(74)
North	0.9x 0.77	x	2.4	x	13.12	x	0.63	x	0.7	=	19.24	(74)
North	0.9x 0.77	x	5.04	x	13.12	x	0.63	x	0.7	=	40.41	(74)
North	0.9x 0.77	x	2.4	x	8.86	x	0.63	x	0.7	=	13	(74)
North	0.9x 0.77	x	5.04	x	8.86	x	0.63	x	0.7	=	27.31	(74)

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West	0.9x	0.77	x	1.2	x	19.64	x	0.63	x	0.7	=	7.2	(80)
West	0.9x	0.77	x	3.6	x	19.64	x	0.63	x	0.7	=	21.61	(80)
West	0.9x	0.77	x	1.2	x	38.42	x	0.63	x	0.7	=	14.09	(80)
West	0.9x	0.77	x	3.6	x	38.42	x	0.63	x	0.7	=	42.27	(80)
West	0.9x	0.77	x	1.2	x	63.27	x	0.63	x	0.7	=	23.2	(80)
West	0.9x	0.77	x	3.6	x	63.27	x	0.63	x	0.7	=	69.61	(80)
West	0.9x	0.77	x	1.2	x	92.28	x	0.63	x	0.7	=	33.84	(80)
West	0.9x	0.77	x	3.6	x	92.28	x	0.63	x	0.7	=	101.53	(80)
West	0.9x	0.77	x	1.2	x	113.09	x	0.63	x	0.7	=	41.48	(80)
West	0.9x	0.77	x	3.6	x	113.09	x	0.63	x	0.7	=	124.43	(80)
West	0.9x	0.77	x	1.2	x	115.77	x	0.63	x	0.7	=	42.46	(80)
West	0.9x	0.77	x	3.6	x	115.77	x	0.63	x	0.7	=	127.37	(80)
West	0.9x	0.77	x	1.2	x	110.22	x	0.63	x	0.7	=	40.42	(80)
West	0.9x	0.77	x	3.6	x	110.22	x	0.63	x	0.7	=	121.26	(80)
West	0.9x	0.77	x	1.2	x	94.68	x	0.63	x	0.7	=	34.72	(80)
West	0.9x	0.77	x	3.6	x	94.68	x	0.63	x	0.7	=	104.16	(80)
West	0.9x	0.77	x	1.2	x	73.59	x	0.63	x	0.7	=	26.99	(80)
West	0.9x	0.77	x	3.6	x	73.59	x	0.63	x	0.7	=	80.96	(80)
West	0.9x	0.77	x	1.2	x	45.59	x	0.63	x	0.7	=	16.72	(80)
West	0.9x	0.77	x	3.6	x	45.59	x	0.63	x	0.7	=	50.16	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	3.6	x	24.49	x	0.63	x	0.7	=	26.94	(80)
West	0.9x	0.77	x	1.2	x	16.15	x	0.63	x	0.7	=	5.92	(80)
West	0.9x	0.77	x	3.6	x	16.15	x	0.63	x	0.7	=	17.77	(80)

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

(83)m=	77.17	148.77	249.85	387.6	505.67	533.56	501.28	408.31	296.75	176.88	95.58	64

(83)

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

(84)m=	478.13	549.6	638.39	753.47	849.27	854.21	805.4	718.13	616.4	519.07	465.55	454.4

(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	1	0.99	0.95	0.82	0.62	0.46	0.53	0.83	0.98	1	1

(86)

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

(87)m=	19.76	19.92	20.21	20.59	20.88	20.98	21	20.99	20.91	20.52	20.08	19.74

(87)

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

(88)m=	20.08	20.09	20.09	20.1	20.1	20.11	20.11	20.11	20.11	20.1	20.1	20.09

(88)

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

(89)m=	1	1	0.99	0.93	0.77	0.54	0.37	0.43	0.76	0.97	1	1

(89)

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

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(90)m=	18.62	18.83	19.19	19.68	20	20.1	20.11	20.11	20.04	19.6	19.04	18.6	(90)

fLA = Living area ÷ (4) = 0.2 (91)

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

(92)m=	18.85	19.05	19.4	19.87	20.18	20.28	20.29	20.29	20.22	19.79	19.25	18.83	(92)

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

(93)m=	18.85	19.05	19.4	19.87	20.18	20.28	20.29	20.29	20.22	19.79	19.25	18.83	(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	0.78	0.55	0.39	0.45	0.77	0.97	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	476.92	546.39	626.68	698.84	659.34	472.16	310.92	325.95	474.75	501.56	462.96	453.53	(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=	1270.94	1232.2	1120.16	939.78	724.64	479.8	311.71	327.86	519.06	785.24	1043.59	1263.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	590.75	460.87	367.15	173.48	48.58	0	0	0	0	211.06	418.05	602.75	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2872.69 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	590.75	460.87	367.15	173.48	48.58	0	0	0	0	211.06	418.05	602.75	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2872.69 (98)

Space heating requirement in kWh/m²/year 32.91 (99)

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

Space heating:

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

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

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

Efficiency of main space heating system 1 90.4 (206)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	590.75	460.87	367.15	173.48	48.58	0	0	0	0	211.06	418.05	602.75	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	653.49	509.81	406.13	191.9	53.74	0	0	0	0	233.47	462.45	666.76	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3177.76 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

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Water heating

Output from water heater (calculated above)

	179.55	160.03	169.58	151.14	148.66	131.88	124.84	137.44	136.16	154.21	166.48	179.3

Efficiency of water heater: 80.3 (216)

(217)m=	87.83	87.56	86.94	85.4	82.57	80.3	80.3	80.3	80.3	85.84	87.27	87.87

(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	204.44	182.77	195.04	176.98	180.04	164.23	155.47	171.16	169.56	179.65	190.75	204.06

Total = Sum(219a)$_{1...12}$ = 2174.14 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3177.76	
Water heating fuel used		2174.14	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	75	(231)
Electricity for lighting		197.91	(232)
Electricity generated by PVs		-741.01	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor**		**Emissions**	
Space heating (main system 1)		0.21	=	667.33	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	456.57	(264)
Space and water heating				1123.9	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	10.2	(267)
Electricity for lighting	(232) x	0.136	=	26.92	(268)
Energy saving/generation technologies					
Item 1		0.136	=	-100.78	(269)
Total CO2, kg/year	sum of (265)…(271) =			1060.24	(272)

TER = 12.14 (273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 87 GAS

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	87.3	(1a) x	2.5	(2a) =	218.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	87.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		218.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
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, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0.09	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.24	(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) =	0.21	(21)

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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												
	0.26	0.26	0.25	0.23	0.22	0.2	0.2	0.19	0.21	0.22	0.23	0.24

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)
(24d)m=	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.2	x1/[1/(1.2)+ 0.04]	=		1.37			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04]	=		4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04]	=		2.75			(27)
Windows Type 4			5.04	x1/[1/(1.2)+ 0.04]	=		5.77			(27)
Walls	48.67	19.68	28.99	x	0.15	=	4.35			(29)
Roof	87.3	0	87.3	x	0.1	=	8.73			(30)
Total area of elements, m²			135.98							(31)
Party wall			57.4	x	0	=	0			(32)
Party floor			87.3							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16349.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 8.46 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.07 (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=	38.48	38.38	38.29	37.85	37.77	37.38	37.38	37.31	37.53	37.77	37.93	38.11	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	82.55	82.45	82.36	81.92	81.84	81.45	81.45	81.38	81.6	81.84	82	82.18	

Average = Sum(39)$_{1...12}$ /12= 81.92 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.95	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.94	0.94	0.94	

Average = Sum(40)$_{1...12}$ /12= 0.94 (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 — 2.59 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	43.29	41.71	40.14	38.56	36.99	35.42	35.42	36.99	38.56	40.14	41.71	43.29	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 118.82 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	44.06	42.48	40.9	39.31	37.72	36.13	36.12	37.7	39.29	40.88	42.49	44.09	

Total = Sum(44)$_{1...12}$ = 481.18 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	186.59	166.44	175.23	153.56	149.68	130.76	120.57	135.34	134.4	155.15	170.74	185.34	

Total = Sum(45)$_{1...12}$ = 1863.8 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	27.99	24.97	26.28	23.03	22.45	19.61	18.09	20.3	20.16	23.27	25.61	27.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)
b) If manufacturer's declared cylinder loss factor is not known:			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If Heat network 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 = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(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=	22.45	19.55	20.84	19.38	19.22	17.82	18.41	19.21	19.37	20.83	20.95	22.47	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	209.05	185.99	196.07	172.94	168.9	148.58	138.98	154.55	153.77	175.98	191.7	207.81	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	-52.93	-46.57	-47.53	-39.11	-36.32	-29.96	-25.36	-30.7	-31.6	-39.06	-45.24	-51.15	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	156.12	139.42	148.54	133.83	132.59	118.62	113.62	123.85	122.17	136.92	146.46	156.66	

Output from water heater (annual)$_{1...12}$ 1628.79 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	67.66	60.23	63.47	55.9	54.57	47.93	44.69	49.8	49.53	56.8	62.01	67.24	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	7.37	6.54	5.32	4.03	3.01	2.54	2.75	3.57	4.79	6.09	7.1	7.57	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	234.02	236.45	230.33	217.3	200.86	185.4	175.08	172.65	178.77	191.79	208.24	223.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(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=	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	(71)

Water heating gains (Table 5)

(72)m=	90.94	89.63	85.31	77.64	73.35	66.57	60.07	66.94	68.79	76.34	86.13	90.38	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	397.13	397.42	385.77	363.78	342.03	319.32	302.7	307.96	317.16	339.02	366.27	386.45	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x 0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x 0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x 0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x 0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x 0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x 0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x 0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)

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West	0.9x	0.77	x	1.2	x	19.64	x	0.3	x	0.7	=	3.43	(80)
West	0.9x	0.77	x	3.6	x	19.64	x	0.3	x	0.7	=	10.29	(80)
West	0.9x	0.77	x	1.2	x	38.42	x	0.3	x	0.7	=	6.71	(80)
West	0.9x	0.77	x	3.6	x	38.42	x	0.3	x	0.7	=	20.13	(80)
West	0.9x	0.77	x	1.2	x	63.27	x	0.3	x	0.7	=	11.05	(80)
West	0.9x	0.77	x	3.6	x	63.27	x	0.3	x	0.7	=	33.15	(80)
West	0.9x	0.77	x	1.2	x	92.28	x	0.3	x	0.7	=	16.12	(80)
West	0.9x	0.77	x	3.6	x	92.28	x	0.3	x	0.7	=	48.35	(80)
West	0.9x	0.77	x	1.2	x	113.09	x	0.3	x	0.7	=	19.75	(80)
West	0.9x	0.77	x	3.6	x	113.09	x	0.3	x	0.7	=	59.25	(80)
West	0.9x	0.77	x	1.2	x	115.77	x	0.3	x	0.7	=	20.22	(80)
West	0.9x	0.77	x	3.6	x	115.77	x	0.3	x	0.7	=	60.65	(80)
West	0.9x	0.77	x	1.2	x	110.22	x	0.3	x	0.7	=	19.25	(80)
West	0.9x	0.77	x	3.6	x	110.22	x	0.3	x	0.7	=	57.74	(80)
West	0.9x	0.77	x	1.2	x	94.68	x	0.3	x	0.7	=	16.53	(80)
West	0.9x	0.77	x	3.6	x	94.68	x	0.3	x	0.7	=	49.6	(80)
West	0.9x	0.77	x	1.2	x	73.59	x	0.3	x	0.7	=	12.85	(80)
West	0.9x	0.77	x	3.6	x	73.59	x	0.3	x	0.7	=	38.55	(80)
West	0.9x	0.77	x	1.2	x	45.59	x	0.3	x	0.7	=	7.96	(80)
West	0.9x	0.77	x	3.6	x	45.59	x	0.3	x	0.7	=	23.88	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	3.6	x	24.49	x	0.3	x	0.7	=	12.83	(80)
West	0.9x	0.77	x	1.2	x	16.15	x	0.3	x	0.7	=	2.82	(80)
West	0.9x	0.77	x	3.6	x	16.15	x	0.3	x	0.7	=	8.46	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.1	100.18	168.82	264.64	348.66	369.55	346.51	279.96	201.24	119.15	64.45	43.28	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	449.22	497.6	554.59	628.42	690.69	688.87	649.21	587.93	518.4	458.17	430.72	429.73	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.97	0.89	0.72	0.54	0.62	0.89	0.99	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.81	19.94	20.18	20.52	20.82	20.96	20.99	20.99	20.87	20.49	20.09	19.79	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.13	20.13	20.13	20.14	20.14	20.14	20.14	20.14	20.14	20.14	20.13	20.13	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.96	0.86	0.64	0.44	0.51	0.83	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	18.72	18.89	19.19	19.62	19.97	20.12	20.14	20.14	20.04	19.59	19.09	18.69	(90)

fLA = Living area ÷ (4) = 0.2 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.1	19.39	19.8	20.14	20.29	20.31	20.31	20.21	19.78	19.29	18.91	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.95	19.1	19.39	19.8	20.14	20.29	20.31	20.31	20.21	19.78	19.29	18.91	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	1	0.99	0.96	0.86	0.65	0.46	0.53	0.84	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	448.4	495.76	548.82	603.06	591.28	448.16	300.54	314.24	434.79	448.35	429.05	429.12	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1208.96	1170.84	1061.88	893.02	690.99	463.39	302.24	318.02	498.31	750.9	999.65	1209.06	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	565.86	453.65	381.72	208.77	74.19	0	0	0	0	225.1	410.83	580.27	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 2900.39 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	565.86	453.65	381.72	208.77	74.19	0	0	0	0	225.1	410.83	580.27	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2900.39 (98)

Space heating requirement in kWh/m²/year 33.22 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 90.4 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	565.86	453.65	381.72	208.77	74.19	0	0	0	0	225.1	410.83	580.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	625.95	501.82	422.25	230.95	82.07	0	0	0	0	249	454.46	641.9	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 3208.4 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

DER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

	156.12	139.42	148.54	133.83	132.59	118.62	113.62	123.85	122.17	136.92	146.46	156.66

Efficiency of water heater 80.3 (216)

(217)m= 88.01 | 87.8 | 87.32 | 86.17 | 83.65 | 80.3 | 80.3 | 80.3 | 80.3 | 86.29 | 87.51 | 88.05 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	177.4	158.79	170.1	155.32	158.49	147.72	141.49	154.23	152.15	158.67	167.36	177.93

Total = Sum(219a)$_{1...12}$ = 1919.65 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3208.4	
Water heating fuel used		1919.65	
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		130.09	(232)
Electricity generated by PVs		-737.22	(233)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)		0.21	=	673.76	(261)
Space heating (secondary)		0.136	=	0	(263)
Water heating		0.21	=	403.13	(264)
Space and water heating				1076.89	(265)
Electricity for pumps, fans and electric keep-hot		0.136	=	4.08	(267)
Electricity for lighting		0.136	=	17.69	(268)
Energy saving/generation technologies Item 1		0.136	=	-100.26	(269)
Total CO2, kg/year	sum of (265)…(271) =			998.4	(272)
Dwelling CO2 Emission Rate	(272) ÷ (4) =			11.44	(273)
EI rating (section 14)				90	(274)

Appendix 2 – DER Worksheets for the Modelled Apartments for the Be Green scenario

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF EXP 54 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

DER WorkSheet: New dwelling design stage

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Floor			53.7	x 0.11 =	5.907			(28)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party ceiling			53.7					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.16 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16793.1 (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 7.05 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 25.22 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	12.03	11.89	11.75	11.04	10.9	10.2	10.2	10.05	10.48	10.9	11.18	11.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	37.25	37.11	36.97	36.26	36.12	35.41	35.41	35.27	35.7	36.12	36.4	36.68	

Average = Sum(39)$_{1...12}$ /12= 36.23 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.69	0.69	0.69	0.68	0.67	0.66	0.66	0.66	0.66	0.67	0.68	0.68	

Average = Sum(40)$_{1...12}$ /12= 0.67 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
If Heat network see section 4.3		
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.6	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	205.27	183.71	196.13	176.93	175.59	158.6	152.19	164.07	161.53	179.99	190.74	204.26	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	205.27	183.71	196.13	176.93	175.59	158.6	152.19	164.07	161.53	179.99	190.74	204.26	

Output from water heater (annual)$_{1...12}$ 2149 (64)

if (64)m < 0 then set to 0

Energy (64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	94.09	84.43	91.05	83.84	84.23	77.74	76.45	80.39	78.72	85.69	88.43	93.76	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	126.47	125.63	122.38	116.44	113.21	107.98	102.75	108.06	109.33	115.17	122.82	126.02	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	338.32	338.55	330.36	314.8	299.86	283.95	271.94	276.18	282.39	297.85	317.21	331.09	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	406.9	450.87	473.44	476.51	468.37	446.12	430.39	430.06	431.85	419	398.5	390.35	(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	0.97	0.93	0.85	0.7	0.51	0.36	0.38	0.57	0.83	0.96	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.52	20.65	20.79	20.92	20.98	21	21	21	21	20.94	20.73	20.5	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.35	20.35	20.35	20.36	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.92	0.82	0.66	0.46	0.31	0.33	0.52	0.8	0.95	0.99	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.79	19.96	20.13	20.29	20.35	20.38	20.38	20.38	20.37	20.31	20.07	19.77	(90)

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.01	20.16	20.33	20.48	20.54	20.56	20.56	20.56	20.55	20.5	20.27	19.99	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.01	20.16	20.33	20.48	20.54	20.56	20.56	20.56	20.55	20.5	20.27	19.99	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.92	0.82	0.67	0.47	0.33	0.34	0.53	0.81	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	398.93	432.45	433.82	392.41	314.12	210.77	140.23	146.78	229.69	337.66	378.81	384.24	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	585.09	566.35	511.17	419.78	319.24	211.05	140.24	146.8	230.42	357.54	479.27	579.16	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	138.5	89.98	57.55	19.71	3.81	0	0	0	0	14.79	72.33	145.02	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 541.68 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	138.5	89.98	57.55	19.71	3.81	0	0	0	0	14.79	72.33	145.02	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 541.68 (98)

Space heating requirement in kWh/m²/year 10.09 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Space heating **kWh/year**

Annual space heating requirement 541.68

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308

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Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2149	
If DHW from community scheme:			
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		114.65	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	114.65	(331)
Energy for lighting (calculated in Appendix L)		88.9	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.16	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				401	(367a)
Electrical energy for heat distribution	[(313) x		0.14	=	0	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)			=	0	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				0	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14	=	15.59	(378)
CO2 associated with electricity for lighting	(332))) x		0.14	=	12.09	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.14	x 0.01 =	-92.77	(380)
Total CO2, kg/year	sum of (376)...(382) =				-65.09	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				-1.21	(384)
EI rating (section 14)					100.88	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF MID 54 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Total area of elements, m²			14.85					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)
Party ceiling			53.7					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.26 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14913.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 0.65 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 12.9 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	12.03	11.89	11.75	11.04	10.9	10.2	10.2	10.05	10.48	10.9	11.18	11.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	24.93	24.79	24.65	23.95	23.81	23.1	23.1	22.96	23.38	23.81	24.09	24.37	

Average = Sum(39)$_{1...12}$ /12= 23.91 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.46	0.46	0.46	0.45	0.44	0.43	0.43	0.43	0.44	0.44	0.45	0.45	

Average = Sum(40)$_{1...12}$ /12= 0.45 (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 1.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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)	0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	195.57	174.96	186.43	167.54	165.9	149.22	142.5	154.37	152.14	170.3	181.36	194.57	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	195.57	174.96	186.43	167.54	165.9	149.22	142.5	154.37	152.14	170.3	181.36	194.57	

Output from water heater (annual)$_{1...12}$ 2034.86 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	86.34	77.42	83.3	76.33	76.47	70.24	68.69	72.64	71.21	77.93	80.92	86	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	116.04	115.21	111.96	106.01	102.78	97.55	92.33	97.63	98.9	104.75	112.39	115.6	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	327.9	328.12	319.94	304.38	289.43	273.52	261.52	265.76	271.97	287.43	306.79	320.67	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	396.48	440.45	463.02	466.09	457.94	435.69	419.97	419.63	421.43	408.57	388.08	379.93	(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=	0.94	0.86	0.76	0.62	0.48	0.34	0.24	0.25	0.38	0.61	0.84	0.95	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.9	20.96	20.99	21	21	21	21	21	21	21	20.98	20.89	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.55	20.56	20.56	20.57	20.57	20.59	20.59	20.59	20.58	20.57	20.57	20.56	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.93	0.85	0.74	0.6	0.46	0.32	0.22	0.23	0.36	0.58	0.82	0.94	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	20.44	20.51	20.55	20.57	20.57	20.59	20.59	20.59	20.58	20.57	20.55	20.44	(90)

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.58	20.64	20.68	20.7	20.7	20.71	20.71	20.71	20.7	20.7	20.67	20.57	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.58	20.64	20.68	20.7	20.7	20.71	20.71	20.71	20.7	20.7	20.67	20.57	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.93	0.85	0.75	0.61	0.47	0.32	0.23	0.24	0.37	0.59	0.82	0.94	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	367.43	375.05	345.59	282.1	214.2	141.07	94.88	98.93	154.41	240.16	318.51	356.6	(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=	405.85	390.36	349.52	282.47	214.21	141.07	94.88	98.93	154.41	240.39	326.92	398.97	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	28.58	10.29	2.92	0.27	0.01	0	0	0	0	0.17	6.05	31.53	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 79.82 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	28.58	10.29	2.92	0.27	0.01	0	0	0	0	0.17	6.05	31.53	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 79.82 (98)

Space heating requirement in kWh/m²/year 1.49 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating	**kWh/year**
Annual space heating requirement	79.82

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	83.81	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2034.86	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2136.6	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	22.2	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		114.65	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	114.65	(331)
Energy for lighting (calculated in Appendix L)		88.9	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.16	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14 =	75.31	(367)
Electrical energy for heat distribution	[(313) x		0.14 =	3.02	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	78.33	(373)
CO2 associated with space heating (secondary)	(309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			78.33	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14 =	15.59	(378)
CO2 associated with electricity for lighting	(332))) x		0.14 =	12.09	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1			0.14 x 0.01 =	-92.77	(380)
Total CO2, kg/year	sum of (376)…(382) =			13.24	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			0.25	(384)
EI rating (section 14)				99.82	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 1BF TOP 54 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	53.7 (1a)	x	2.5 (2a)	=	134.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	53.7 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	134.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	14.85	10.08	4.77	x 0.15 =	0.72			(29)
Roof	53.7	0	53.7	x 0.1 =	5.37			(30)
Total area of elements, m²			68.55					(31)
Party wall			60.38	x 0 =	0			(32)
Party floor			53.7					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 17.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13785.9 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 24.31 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	12.03	11.89	11.75	11.04	10.9	10.2	10.2	10.05	10.48	10.9	11.18	11.47	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	36.34	36.2	36.06	35.36	35.21	34.51	34.51	34.37	34.79	35.21	35.5	35.78	

Average = Sum(39)$_{1...12}$ /12= 35.32 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.68	0.67	0.67	0.66	0.66	0.64	0.64	0.64	0.65	0.66	0.66	0.67	

Average = Sum(40)$_{1...12}$ /12= 0.66 (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 1.8 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	34.8	33.53	32.26	31	29.73	28.47	28.47	29.73	31	32.26	33.53	34.8	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 95.51 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	35.57	34.3	33.03	31.74	30.46	29.18	29.17	30.45	31.72	33	34.31	35.6	

Total = Sum(44)$_{1...12}$ = 388.54 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	149.99	133.79	140.85	123.43	120.32	105.11	96.92	108.79	108.03	124.71	137.25	148.98	

Total = Sum(45)$_{1...12}$ = 1498.16 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.5	20.07	21.13	18.51	18.05	15.77	14.54	16.32	16.2	18.71	20.59	22.35	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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)	0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	195.57	174.96	186.43	167.54	165.9	149.22	142.5	154.37	152.14	170.3	181.36	194.57	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	195.57	174.96	186.43	167.54	165.9	149.22	142.5	154.37	152.14	170.3	181.36	194.57	

Output from water heater (annual)$_{1...12}$ 2034.86 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	86.34	77.42	83.3	76.33	76.47	70.24	68.69	72.64	71.21	77.93	80.92	86	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	89.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	5.03	4.47	3.64	2.75	2.06	1.74	1.88	2.44	3.28	4.16	4.85	5.17	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	156.83	158.46	154.36	145.63	134.6	124.25	117.33	115.7	119.8	128.53	139.55	149.91	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	32	32	32	32	32	32	32	32	32	32	32	32	(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=	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	-71.97	(71)

Water heating gains (Table 5)

(72)m=	116.04	115.21	111.96	106.01	102.78	97.55	92.33	97.63	98.9	104.75	112.39	115.6	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	327.9	328.12	319.94	304.38	289.43	273.52	261.52	265.76	271.97	287.43	306.79	320.67	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	68.58	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	112.32	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	143.08	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	161.71	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	168.51	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	162.17	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	158.45	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	153.87	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	149.46	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	121.15	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	81.29	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	59.26	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	68.58	112.32	143.08	161.71	168.51	162.17	158.45	153.87	149.46	121.15	81.29	59.26	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	396.48	440.45	463.02	466.09	457.94	435.69	419.97	419.63	421.43	408.57	388.08	379.93	(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=	0.99	0.97	0.93	0.85	0.7	0.51	0.36	0.38	0.57	0.84	0.96	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.53	20.66	20.8	20.93	20.99	21	21	21	21	20.95	20.74	20.51	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.37	20.38	20.38	20.39	20.39	20.39	20.39	20.38	20.38	20.37	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.92	0.82	0.66	0.46	0.31	0.33	0.52	0.8	0.95	0.99	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.82	19.98	20.16	20.31	20.37	20.39	20.39	20.39	20.39	20.33	20.09	19.8	(90)

fLA = Living area ÷ (4) = 0.29 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.03	20.18	20.35	20.49	20.55	20.57	20.57	20.57	20.57	20.51	20.28	20.01	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.03	20.18	20.35	20.49	20.55	20.57	20.57	20.57	20.57	20.51	20.28	20.01	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.92	0.82	0.67	0.47	0.33	0.34	0.53	0.81	0.95	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	389.3	423.24	425.08	384.21	307.04	205.79	137.01	143.38	224.32	330.24	369.9	374.5	(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=	571.62	553.28	499.33	409.84	311.66	206.02	137.02	143.39	224.95	349.05	467.95	565.6	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	135.65	87.39	55.24	18.45	3.44	0	0	0	0	13.99	70.6	142.18	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 526.93 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	135.65	87.39	55.24	18.45	3.44	0	0	0	0	13.99	70.6	142.18	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 526.93 (98)

Space heating requirement in kWh/m²/year 9.81 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating	**kWh/year**
Annual space heating requirement	526.93

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	553.28	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2034.86	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2136.6	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	26.9	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		114.65	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	114.65	(331)
Energy for lighting (calculated in Appendix L)		88.9	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.16	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14 =	91.23	(367)
Electrical energy for heat distribution	[(313) x		0.14 =	3.66	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	94.89	(373)
CO2 associated with space heating (secondary)	(309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			94.89	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14 =	15.59	(378)
CO2 associated with electricity for lighting	(332))) x		0.14 =	12.09	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1			0.14 x 0.01 =	-92.77	(380)
Total CO2, kg/year	sum of (376)…(382) =			29.8	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			0.55	(384)
EI rating (section 14)				99.6	(385)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 74 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7	(1a) x	2.5	(2a) =	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 2			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 5			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Floor			73.7	x 0.11 =	8.106999			(28)
Walls	75.43	25.68	49.75	x 0.15 =	7.46			(29)
Total area of elements, m²			149.13					(31)
Party wall			28.55	x 0 =	0			(32)
Party ceiling			73.7					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 44.97 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15862.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 7.52 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = — 52.49 (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=	16.51	16.32	16.12	15.16	14.96	13.99	13.99	13.8	14.38	14.96	15.35	15.74	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	69	68.81	68.62	67.65	67.45	66.49	66.49	66.29	66.87	67.45	67.84	68.23	

Average = Sum(39)$_{1...12}$ /12= 67.6 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.94	0.93	0.93	0.92	0.92	0.9	0.9	0.9	0.91	0.92	0.92	0.93	

Average = Sum(40)$_{1...12}$ /12= 0.92 (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 — 2.33 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.72	(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 Heat network 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)		0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	220.35	197.06	209.7	187.94	185.78	166.59	158.51	172.35	169.99	190.9	204.03	219.18	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	220.35	197.06	209.7	187.94	185.78	166.59	158.51	172.35	169.99	190.9	204.03	219.18	

Output from water heater (annual)$_{1...12}$ 2282.4 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	94.58	84.77	91.04	83.11	83.08	76.01	74.02	78.62	77.15	84.79	88.46	94.19	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	6.49	5.76	4.69	3.55	2.65	2.24	2.42	3.14	4.22	5.36	6.25	6.67	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	127.12	126.15	122.36	115.43	111.67	105.57	99.48	105.67	107.15	113.96	122.87	126.6	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	397.37	397.81	387.56	368.04	348.92	328.82	313.83	318.61	326.54	345.95	370.21	387.95	(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)	
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	3.6	x	10.63	x	0.5	x	0.7	=	9.28	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	3.6	x	20.32	x	0.5	x	0.7	=	17.74	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	3.6	x	34.53	x	0.5	x	0.7	=	30.15	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	3.6	x	55.46	x	0.5	x	0.7	=	48.43	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	3.6	x	74.72	x	0.5	x	0.7	=	65.24	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	3.6	x	79.99	x	0.5	x	0.7	=	69.84	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	3.6	x	74.68	x	0.5	x	0.7	=	65.21	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	3.6	x	59.25	x	0.5	x	0.7	=	51.73	(74)

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North	0.9x	0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.5	x	0.7	=	36.25	(74)
North	0.9x	0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.5	x	0.7	=	21.12	(74)
North	0.9x	0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.5	x	0.7	=	11.45	(74)
North	0.9x	0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.5	x	0.7	=	7.74	(74)
East	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(76)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	13.72	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	26.84	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	44.2	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	64.46	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	79	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	80.87	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	76.99	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	66.14	(80)
West	0.9x	0.77	x	2.4	x	73.59	x	0.3	x	0.7	=	51.41	(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	31.85	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	17.11	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	11.28	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	68.24	131.34	221.07	345.3	453.4	479.83	450.21	364.76	263.2	156.19	84.46	56.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	465.61	529.15	608.64	713.34	802.32	808.65	764.05	683.37	589.74	502.14	454.67	444.6	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.98	0.91	0.74	0.52	0.38	0.44	0.74	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.12	20.4	20.74	20.94	20.99	21	21	20.96	20.67	20.25	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.15	20.15	20.17	20.17	20.17	20.16	20.15	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.88	0.68	0.46	0.31	0.37	0.66	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.92	19.12	19.47	19.9	20.11	20.16	20.17	20.17	20.13	19.82	19.3	18.89	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.47	19.79	20.19	20.4	20.45	20.46	20.46	20.42	20.12	19.64	19.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.47	19.79	20.19	20.4	20.45	20.46	20.46	20.42	20.12	19.64	19.26	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	1	0.99	0.97	0.89	0.7	0.48	0.34	0.39	0.69	0.94	0.99	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	463.37	523.54	589.43	631.81	560.31	386.88	256.25	268.49	405.48	472.14	449.76	442.94	(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=	1033.74	1002.59	912.25	764	586.96	389.17	256.46	269.02	422.82	641.87	850.48	1027.3	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(97a)m=	424.35	321.92	240.18	95.18	19.83	0	0	0	0	126.28	288.52	434.76	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1951.03 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	424.35	321.92	240.18	95.18	19.83	0	0	0	0	126.28	288.52	434.76	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1951.03 (98)

Space heating requirement in kWh/m²/year 26.47 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

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Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for Heat network system		1	(305)
Distribution loss factor (Table 12c) for Heat network system		1.05	(306)

Space heating — **kWh/year**

Annual space heating requirement		1951.03	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	2048.58	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2282.4	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2396.52	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	44.45	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		157.35	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.35	(331)
Energy for lighting (calculated in Appendix L)		114.56	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-936.22	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14	=	150.76	(367)
Electrical energy for heat distribution	[(313) x		0.14	=	6.05	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	156.8	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				156.8	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14	=	21.4	(378)
CO2 associated with electricity for lighting	(332))) x		0.14	=	15.58	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.14	x 0.01 =	-127.33	(380)

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Total CO2, kg/year	sum of (376)…(382) =	66.46	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	0.9	(384)
EI rating (section 14)		99.25	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 74 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	73.7	(1a) x	2.5	(2a) =	184.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	73.7	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		184.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 2			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 5			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Walls	75.43	25.68	49.75	x 0.15 =	7.46			(29)
Total area of elements, m²			75.43					(31)
Party wall			28.55	x 0 =	0			(32)
Party floor			73.7					(32a)
Party ceiling			73.7					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.87 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13283 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 2.73 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 39.59 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	16.51	16.32	16.12	15.16	14.96	13.99	13.99	13.8	14.38	14.96	15.35	15.74	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	56.11	55.91	55.72	54.75	54.55	53.59	53.59	53.39	53.97	54.55	54.94	55.33	

Average = Sum(39)$_{1...12}$ /12= 54.7 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.76	0.76	0.76	0.74	0.74	0.73	0.73	0.72	0.73	0.74	0.75	0.75	

Average = Sum(40)$_{1...12}$ /12= 0.74 (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 — 2.33 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	40.54	39.07	37.6	36.12	34.65	33.17	33.17	34.65	36.12	37.6	39.07	40.54	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 111.29 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.32	39.84	38.36	36.86	35.37	33.88	33.88	35.36	36.84	38.34	39.85	41.35	

Total = Sum(44)$_{1...12}$ = 451.26 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	174.77	155.89	164.12	143.83	140.2	122.48	112.93	126.77	125.88	145.32	159.92	173.6	

Total = Sum(45)$_{1...12}$ = 1745.71 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.22	23.38	24.62	21.57	21.03	18.37	16.94	19.01	18.88	21.8	23.99	26.04	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.72	(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 Heat network 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)		0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	220.35	197.06	209.7	187.94	185.78	166.59	158.51	172.35	169.99	190.9	204.03	219.18	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	220.35	197.06	209.7	187.94	185.78	166.59	158.51	172.35	169.99	190.9	204.03	219.18	

Output from water heater (annual)$_{1...12}$ 2282.4 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	94.58	84.77	91.04	83.11	83.08	76.01	74.02	78.62	77.15	84.79	88.46	94.19	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	116.63	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	6.49	5.76	4.69	3.55	2.65	2.24	2.42	3.14	4.22	5.36	6.25	6.67	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	205.77	207.91	202.53	191.07	176.61	163.02	153.94	151.81	157.19	168.64	183.1	196.69	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	34.66	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	-93.3	(71)

Water heating gains (Table 5)

(72)m=	127.12	126.15	122.36	115.43	111.67	105.57	99.48	105.67	107.15	113.96	122.87	126.6	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	397.37	397.81	387.56	368.04	348.92	328.82	313.83	318.61	326.54	345.95	370.21	387.95	(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)	
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	3.6	x	10.63	x	0.5	x	0.7	=	9.28	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	3.6	x	20.32	x	0.5	x	0.7	=	17.74	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	3.6	x	34.53	x	0.5	x	0.7	=	30.15	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	3.6	x	55.46	x	0.5	x	0.7	=	48.43	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	3.6	x	74.72	x	0.5	x	0.7	=	65.24	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	3.6	x	79.99	x	0.5	x	0.7	=	69.84	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	3.6	x	74.68	x	0.5	x	0.7	=	65.21	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	3.6	x	59.25	x	0.5	x	0.7	=	51.73	(74)

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North	0.9x	0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x	0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x	0.77	x	3.6	x	41.52	x	0.5	x	0.7	=	36.25	(74)
North	0.9x	0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x	0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x	0.77	x	3.6	x	24.19	x	0.5	x	0.7	=	21.12	(74)
North	0.9x	0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x	0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x	0.77	x	3.6	x	13.12	x	0.5	x	0.7	=	11.45	(74)
North	0.9x	0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)
North	0.9x	0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x	0.77	x	3.6	x	8.86	x	0.5	x	0.7	=	7.74	(74)
East	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(76)
East	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(76)
East	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(76)
East	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(76)
East	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(76)
East	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(76)
East	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(76)
East	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(76)
East	0.9x		x		x		x		x		=		(76)
East	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(76)
East	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(76)
East	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(76)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	13.72	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	26.84	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	44.2	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	64.46	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	79	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	80.87	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	76.99	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	66.14	(80)
West	0.9x	0.77	x	2.4	x	73.59	x	0.3	x	0.7	=	51.41	(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	31.85	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	17.11	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	11.28	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m=	68.24	131.34	221.07	345.3	453.4	479.83	450.21	364.76	263.2	156.19	84.46	56.66	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m=	465.61	529.15	608.64	713.34	802.32	808.65	764.05	683.37	589.74	502.14	454.67	444.6	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	1	0.99	0.96	0.84	0.62	0.42	0.31	0.36	0.62	0.93	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.26	20.41	20.65	20.9	20.99	21	21	21	20.99	20.84	20.51	20.24	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.29	20.29	20.29	20.3	20.31	20.32	20.32	20.32	20.31	20.31	20.3	20.3	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.95	0.81	0.58	0.38	0.26	0.31	0.56	0.9	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.42	19.61	19.91	20.21	20.3	20.32	20.32	20.32	20.31	20.15	19.74	19.4	(90)

fLA = Living area ÷ (4) = 0.35 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.71	19.89	20.17	20.46	20.54	20.56	20.56	20.56	20.55	20.39	20.01	19.69	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.71	19.89	20.17	20.46	20.54	20.56	20.56	20.56	20.55	20.39	20.01	19.69	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.95	0.82	0.59	0.39	0.28	0.32	0.58	0.9	0.99	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	462.91	521.53	579.14	584.8	477.37	318.94	211.98	221.94	344.95	454.04	447.89	442.66	(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=	864.67	838.15	761.79	632.64	482.24	319.14	211.99	221.98	347.98	534.14	709.37	857.07	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(97a)m=	298.91	212.77	135.89	34.45	3.62	0	0	0	0	59.6	188.27	308.33	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1241.82 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	298.91	212.77	135.89	34.45	3.62	0	0	0	0	59.6	188.27	308.33	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1241.82 (98)

Space heating requirement in kWh/m²/year 16.85 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

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Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for Heat network system		1	(305)
Distribution loss factor (Table 12c) for Heat network system		1.05	(306)

Space heating — **kWh/year**

Annual space heating requirement		1241.82	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1303.91	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2282.4	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2396.52	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	37	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		157.35	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	157.35	(331)
Energy for lighting (calculated in Appendix L)		114.56	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-936.22	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14	=	125.5	(367)
Electrical energy for heat distribution	[(313) x		0.14	=	5.03	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	130.53	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				130.53	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14	=	21.4	(378)
CO2 associated with electricity for lighting	(332))) x		0.14	=	15.58	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.14	x 0.01 =	-127.33	(380)

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Total CO2, kg/year	sum of (376)…(382) =	40.19	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =	0.55	(384)
EI rating (section 14)		99.55	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 76 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	75.9 (1a)	x	2.5 (2a)	=	189.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	75.9 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		189.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	21.18	15.12	6.06	x 0.15 =	0.91			(29)
Roof	75.9	0	75.9	x 0.1 =	7.59			(30)
Total area of elements, m²			97.08					(31)
Party wall			74.58	x 0 =	0			(32)
Party floor			75.9					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 25.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17507.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.69 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

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Total fabric heat loss (33) + (36) = 34.5 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	17	16.8	16.61	15.61	15.41	14.41	14.41	14.21	14.81	15.41	15.81	16.21	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	51.5	51.3	51.1	50.1	49.91	48.91	48.91	48.71	49.31	49.91	50.3	50.7	

Average = Sum(39)$_{1...12}$ /12= 50.05 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.68	0.68	0.67	0.66	0.66	0.64	0.64	0.64	0.65	0.66	0.66	0.67	

Average = Sum(40)$_{1...12}$ /12= 0.66 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA <= 13.9, N = 1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	41.06	39.57	38.08	36.58	35.09	33.6	33.6	35.09	36.58	38.08	39.57	41.06	

Annual average hot water usage in litres per day Vd,average (from Appendix J) 112.71 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	41.84	40.34	38.84	37.32	35.82	34.31	34.3	35.8	37.3	38.82	40.35	41.87	

Total = Sum(44)$_{1...12}$ = 456.9 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	177	157.88	166.22	145.66	141.99	124.04	114.37	128.38	127.49	147.17	161.96	175.81	

Total = Sum(45)$_{1...12}$ = 1767.97 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	26.55	23.68	24.93	21.85	21.3	18.61	17.16	19.26	19.12	22.08	24.29	26.37	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.2 (48)

Temperature factor from Table 2b 0.6 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.72 (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If Heat network 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)	0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	222.58	199.05	211.8	189.77	187.57	168.15	159.95	173.96	171.6	192.76	206.07	221.4	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	222.58	199.05	211.8	189.77	187.57	168.15	159.95	173.96	171.6	192.76	206.07	221.4	

Output from water heater (annual)$_{1...12}$ 2304.67 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	95.32	85.43	91.73	83.72	83.68	76.53	74.49	79.15	77.68	85.4	89.14	94.92	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	119.02	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	6.69	5.94	4.83	3.66	2.73	2.31	2.49	3.24	4.35	5.53	6.45	6.87	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	210.66	212.85	207.34	195.61	180.81	166.89	157.6	155.41	160.92	172.65	187.45	201.36	(68)

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	-95.22	(71)

Water heating gains (Table 5)

(72)m=	128.12	127.13	123.3	116.28	112.47	106.3	100.13	106.39	107.89	114.79	123.81	127.59	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	404.17	404.62	394.17	374.25	354.72	334.2	318.93	323.75	331.87	351.67	376.42	394.53	(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)	
South	0.9x	0.77	x 5.04	x	46.75	x	0.3	x	0.7	=	102.87	(78)
South	0.9x	0.77	x 5.04	x	76.57	x	0.3	x	0.7	=	168.48	(78)
South	0.9x	0.77	x 5.04	x	97.53	x	0.3	x	0.7	=	214.61	(78)
South	0.9x	0.77	x 5.04	x	110.23	x	0.3	x	0.7	=	242.56	(78)
South	0.9x	0.77	x 5.04	x	114.87	x	0.3	x	0.7	=	252.76	(78)
South	0.9x	0.77	x 5.04	x	110.55	x	0.3	x	0.7	=	243.25	(78)
South	0.9x	0.77	x 5.04	x	108.01	x	0.3	x	0.7	=	237.67	(78)
South	0.9x	0.77	x 5.04	x	104.89	x	0.3	x	0.7	=	230.81	(78)
South	0.9x	0.77	x 5.04	x	101.89	x	0.3	x	0.7	=	224.19	(78)
South	0.9x	0.77	x 5.04	x	82.59	x	0.3	x	0.7	=	181.72	(78)
South	0.9x	0.77	x 5.04	x	55.42	x	0.3	x	0.7	=	121.94	(78)
South	0.9x	0.77	x 5.04	x	40.4	x	0.3	x	0.7	=	88.89	(78)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	102.87	168.48	214.61	242.56	252.76	243.25	237.67	230.81	224.19	181.72	121.94	88.89	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	507.05	573.1	608.79	616.82	607.48	577.45	556.6	554.56	556.06	533.39	498.36	483.42	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.88	0.74	0.54	0.39	0.4	0.61	0.88	0.98	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.45	20.59	20.75	20.9	20.98	21	21	21	21	20.92	20.67	20.43	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.36	20.36	20.36	20.38	20.38	20.39	20.39	20.39	20.39	20.38	20.37	20.37	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.94	0.86	0.7	0.49	0.33	0.35	0.56	0.85	0.97	0.99	(89)

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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.72	19.9	20.1	20.28	20.36	20.39	20.39	20.39	20.38	20.31	20.01	19.69

(90)

fLA = Living area ÷ (4) = 0.23 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.88	20.06	20.25	20.42	20.5	20.53	20.53	20.53	20.52	20.44	20.16	19.86

(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.88	20.06	20.25	20.42	20.5	20.53	20.53	20.53	20.52	20.44	20.16	19.86

(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains, hm:												
(94)m=	0.99	0.97	0.94	0.86	0.71	0.5	0.35	0.36	0.57	0.85	0.97	0.99
Useful gains, hmGm , W = (94)m x (84)m												
(95)m=	501.81	558.37	572.22	528.9	429.76	289.38	192.1	201.14	315.24	453.13	483.91	479.69
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
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]												
(97)m=	802.54	777.57	702.43	577.34	439.23	289.89	192.13	201.17	316.65	491.3	657.02	794.04
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m												
(97a)m=	223.74	147.3	96.88	34.87	7.05	0	0	0	0	28.4	124.64	233.88

(97)

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 896.76 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	223.74	147.3	96.88	34.87	7.05	0	0	0	0	28.4	124.64	233.88

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 896.76 (98)

Space heating requirement in kWh/m²/year 11.81 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating	**kWh/year**
Annual space heating requirement	896.76

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Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	941.59	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)

Water heating

Annual water heating requirement		2304.67	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2419.9	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	33.61	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		162.05	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	162.05	(331)
Energy for lighting (calculated in Appendix L)		118.13	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-964.17	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14 =	114.01	(367)
Electrical energy for heat distribution	[(313) x		0.14 =	4.57	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	118.58	(373)
CO2 associated with space heating (secondary)	(309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			118.58	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14 =	22.04	(378)
CO2 associated with electricity for lighting	(332))) x		0.14 =	16.07	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1			0.14 x 0.01 =	-131.13	(380)
Total CO2, kg/year	sum of (376)…(382) =			25.55	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			0.34	(384)
EI rating (section 14)				99.72	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF EXP 84 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9 (1a)	x	2.5 (2a)	=	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Floor			83.9	x 0.11 =	9.229			(28)
Walls	55.6	13.44	42.16	x 0.15 =	6.32			(29)
Total area of elements, m²			139.5					(31)
Party wall			77.58	x 0 =	0			(32)
Party ceiling			83.9					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.94 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 25303.5 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 10.82 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 41.76 (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=	18.8	18.58	18.36	17.25	17.03	15.93	15.93	15.71	16.37	17.03	17.47	17.91	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	60.56	60.34	60.12	59.01	58.79	57.69	57.69	57.47	58.13	58.79	59.23	59.68	

Average = Sum(39)$_{1...12}$ /12= 58.96 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.72	0.72	0.72	0.7	0.7	0.69	0.69	0.68	0.69	0.7	0.71	0.71	

Average = Sum(40)$_{1...12}$ /12= 0.7 (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 — 2.53 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.72	(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 Heat network 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)		0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	229.66	205.36	218.44	195.59	193.24	173.11	164.52	179.1	176.69	198.64	212.55	228.42	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	229.66	205.36	218.44	195.59	193.24	173.11	164.52	179.1	176.69	198.64	212.55	228.42	

Output from water heater (annual)$_{1...12}$ 2375.33 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	97.67	87.53	93.94	85.66	85.56	78.18	76.01	80.86	79.37	87.36	91.29	97.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	7.47	6.63	5.4	4.08	3.05	2.58	2.79	3.62	4.86	6.17	7.2	7.68	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	131.28	130.25	126.27	118.97	115	108.58	102.17	108.68	110.24	117.42	126.8	130.73	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	427.14	427.64	416.46	395.2	374.22	352.31	336.07	341.05	349.8	370.94	397.34	416.76	(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)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.3	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.3	x	0.7	=	24.49	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.3	x	0.7	=	16.33	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.3	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.3	x	0.7	=	40.11	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.3	x	0.7	=	26.74	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.3	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.3	x	0.7	=	51.1	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.3	x	0.7	=	34.07	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.3	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.3	x	0.7	=	57.75	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.3	x	0.7	=	38.5	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.3	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.3	x	0.7	=	60.18	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.3	x	0.7	=	40.12	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.3	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.3	x	0.7	=	57.92	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.3	x	0.7	=	38.61	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.3	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.3	x	0.7	=	56.59	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.3	x	0.7	=	37.73	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.3	x	0.7	=	76.94	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.3	x	0.7	=	54.96	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.3	x	0.7	=	36.64	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.3	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.3	x	0.7	=	53.38	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.3	x	0.7	=	35.59	(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.3	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.3	x	0.7	=	43.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.3	x	0.7	=	28.84	(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.3	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.3	x	0.7	=	29.03	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.3	x	0.7	=	19.36	(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.3	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.3	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.3	x	0.7	=	14.11	(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	81.97	136.44	178.8	209.34	224.06	218.05	212.03	201.6	189.4	148.61	97.59	70.55

(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	509.11	564.07	595.27	604.54	598.28	570.35	548.1	542.65	539.2	519.55	494.93	487.31

(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	1	0.99	0.98	0.94	0.84	0.64	0.46	0.49	0.72	0.94	0.99	1

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.3	20.43	20.6	20.8	20.94	20.99	21	21	20.98	20.83	20.54	20.28

(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.32	20.33	20.34	20.34	20.35	20.35	20.35	20.35	20.34	20.34	20.33

(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.93	0.8	0.58	0.39	0.42	0.66	0.92	0.99	1

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	19.5	19.66	19.88	20.13	20.29	20.35	20.35	20.35	20.34	20.17	19.81	19.48	(90)

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.65	19.81	20.02	20.26	20.41	20.47	20.47	20.48	20.46	20.3	19.95	19.63	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.65	19.81	20.02	20.26	20.41	20.47	20.47	20.48	20.46	20.3	19.95	19.63	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.92	0.8	0.59	0.41	0.43	0.67	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	506.44	557.4	578.44	558.42	481.52	336.19	223.39	234.06	363.03	478.26	488.05	485.37	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	929.6	899.49	812.57	670.33	512.17	338.66	223.52	234.26	369.68	570.16	761.02	921	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	314.83	229.88	174.19	80.57	22.8	0	0	0	0	68.37	196.54	324.11	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1411.3 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	314.83	229.88	174.19	80.57	22.8	0	0	0	0	68.37	196.54	324.11	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1411.3 (98)

Space heating requirement in kWh/m²/year 16.82 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating	**kWh/year**	
Annual space heating requirement	1411.3	
Space heat from Community heat pump (98) x (304a) x (305) x (306) =	1481.86	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308

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Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2375.33	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2494.1	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	39.76	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		179.13	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	179.13	(331)
Energy for lighting (calculated in Appendix L)		131.91	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-1065.79	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14	=	134.85	(367)
Electrical energy for heat distribution	[(313) x		0.14	=	5.41	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	140.25	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				140.25	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14	=	24.36	(378)
CO2 associated with electricity for lighting	(332))) x		0.14	=	17.94	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.14	x 0.01 =	-144.95	(380)
Total CO2, kg/year	sum of (376)…(382) =				37.61	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				0.45	(384)
EI rating (section 14)					99.61	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF MID 84 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	83.9 (1a)	x	2.5 (2a)	=	209.75	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	83.9 (4)					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		209.75	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Walls	55.6	13.44	42.16	x 0.15 =	6.32			(29)
Total area of elements, m²			55.6					(31)
Party wall			77.58	x 0 =	0			(32)
Party floor			83.9					(32a)
Party ceiling			83.9					(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 21.71 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22367 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

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can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 1.86 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = — 23.57 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.8	18.58	18.36	17.25	17.03	15.93	15.93	15.71	16.37	17.03	17.47	17.91	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	42.37	42.15	41.93	40.83	40.61	39.5	39.5	39.28	39.94	40.61	41.05	41.49	

Average = Sum(39)$_{1...12}$ /12= 40.77 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.51	0.5	0.5	0.49	0.48	0.47	0.47	0.47	0.48	0.48	0.49	0.49	

Average = Sum(40)$_{1...12}$ /12= 0.49 (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 — 2.53 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	42.7	41.15	39.6	38.04	36.49	34.94	34.94	36.49	38.04	39.6	41.15	42.7	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 117.21 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	43.48	41.92	40.36	38.79	37.22	35.65	35.64	37.2	38.77	40.34	41.93	43.51	

Total = Sum(44)$_{1...12}$ = 474.8 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	184.07	164.19	172.86	151.48	147.66	129	118.94	133.51	132.58	153.06	168.44	182.84	

Total = Sum(45)$_{1...12}$ = 1838.63 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	27.61	24.63	25.93	22.72	22.15	19.35	17.84	20.03	19.89	22.96	25.27	27.43	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.72	(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 Heat network 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)		0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	229.66	205.36	218.44	195.59	193.24	173.11	164.52	179.1	176.69	198.64	212.55	228.42	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	229.66	205.36	218.44	195.59	193.24	173.11	164.52	179.1	176.69	198.64	212.55	228.42	

Output from water heater (annual)$_{1...12}$ 2375.33 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	97.67	87.53	93.94	85.66	85.56	78.18	76.01	80.86	79.37	87.36	91.29	97.26	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	126.64	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	7.47	6.63	5.4	4.08	3.05	2.58	2.79	3.62	4.86	6.17	7.2	7.68	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	227.4	229.76	223.81	211.15	195.17	180.15	170.12	167.76	173.71	186.37	202.35	217.36	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	35.66	(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=	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	-101.31	(71)

Water heating gains (Table 5)

(72)m=	131.28	130.25	126.27	118.97	115	108.58	102.17	108.68	110.24	117.42	126.8	130.73	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	427.14	427.64	416.46	395.2	374.22	352.31	336.07	341.05	349.8	370.94	397.34	416.76	(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)	
South	0.9x 0.77	x	5.04	x	46.75	x	0.3	x	0.7	=	34.29	(78)
South	0.9x 0.77	x	3.6	x	46.75	x	0.3	x	0.7	=	24.49	(78)
South	0.9x 0.77	x	2.4	x	46.75	x	0.3	x	0.7	=	16.33	(78)
South	0.9x 0.77	x	5.04	x	76.57	x	0.3	x	0.7	=	56.16	(78)
South	0.9x 0.77	x	3.6	x	76.57	x	0.3	x	0.7	=	40.11	(78)
South	0.9x 0.77	x	2.4	x	76.57	x	0.3	x	0.7	=	26.74	(78)
South	0.9x 0.77	x	5.04	x	97.53	x	0.3	x	0.7	=	71.54	(78)
South	0.9x 0.77	x	3.6	x	97.53	x	0.3	x	0.7	=	51.1	(78)
South	0.9x 0.77	x	2.4	x	97.53	x	0.3	x	0.7	=	34.07	(78)
South	0.9x 0.77	x	5.04	x	110.23	x	0.3	x	0.7	=	80.85	(78)
South	0.9x 0.77	x	3.6	x	110.23	x	0.3	x	0.7	=	57.75	(78)
South	0.9x 0.77	x	2.4	x	110.23	x	0.3	x	0.7	=	38.5	(78)
South	0.9x 0.77	x	5.04	x	114.87	x	0.3	x	0.7	=	84.25	(78)
South	0.9x 0.77	x	3.6	x	114.87	x	0.3	x	0.7	=	60.18	(78)
South	0.9x 0.77	x	2.4	x	114.87	x	0.3	x	0.7	=	40.12	(78)
South	0.9x 0.77	x	5.04	x	110.55	x	0.3	x	0.7	=	81.08	(78)
South	0.9x 0.77	x	3.6	x	110.55	x	0.3	x	0.7	=	57.92	(78)
South	0.9x 0.77	x	2.4	x	110.55	x	0.3	x	0.7	=	38.61	(78)
South	0.9x 0.77	x	5.04	x	108.01	x	0.3	x	0.7	=	79.22	(78)
South	0.9x 0.77	x	3.6	x	108.01	x	0.3	x	0.7	=	56.59	(78)
South	0.9x 0.77	x	2.4	x	108.01	x	0.3	x	0.7	=	37.73	(78)
South	0.9x 0.77	x	5.04	x	104.89	x	0.3	x	0.7	=	76.94	(78)
South	0.9x 0.77	x	3.6	x	104.89	x	0.3	x	0.7	=	54.96	(78)
South	0.9x 0.77	x	2.4	x	104.89	x	0.3	x	0.7	=	36.64	(78)

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South	0.9x	0.77	x	5.04	x	101.89	x	0.3	x	0.7	=	74.73	(78)
South	0.9x	0.77	x	3.6	x	101.89	x	0.3	x	0.7	=	53.38	(78)
South	0.9x	0.77	x	2.4	x	101.89	x	0.3	x	0.7	=	35.59	(78)
South	0.9x	0.77	x	5.04	x	82.59	x	0.3	x	0.7	=	60.57	(78)
South	0.9x	0.77	x	3.6	x	82.59	x	0.3	x	0.7	=	43.27	(78)
South	0.9x	0.77	x	2.4	x	82.59	x	0.3	x	0.7	=	28.84	(78)
South	0.9x	0.77	x	5.04	x	55.42	x	0.3	x	0.7	=	40.65	(78)
South	0.9x	0.77	x	3.6	x	55.42	x	0.3	x	0.7	=	29.03	(78)
South	0.9x	0.77	x	2.4	x	55.42	x	0.3	x	0.7	=	19.36	(78)
South	0.9x	0.77	x	5.04	x	40.4	x	0.3	x	0.7	=	29.63	(78)
South	0.9x	0.77	x	3.6	x	40.4	x	0.3	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	2.4	x	40.4	x	0.3	x	0.7	=	14.11	(78)
West	0.9x	0.77	x	2.4	x	19.64	x	0.3	x	0.7	=	6.86	(80)
West	0.9x	0.77	x	2.4	x	38.42	x	0.3	x	0.7	=	13.42	(80)
West	0.9x	0.77	x	2.4	x	63.27	x	0.3	x	0.7	=	22.1	(80)
West	0.9x	0.77	x	2.4	x	92.28	x	0.3	x	0.7	=	32.23	(80)
West	0.9x	0.77	x	2.4	x	113.09	x	0.3	x	0.7	=	39.5	(80)
West	0.9x	0.77	x	2.4	x	115.77	x	0.3	x	0.7	=	40.44	(80)
West	0.9x	0.77	x	2.4	x	110.22	x	0.3	x	0.7	=	38.5	(80)
West	0.9x	0.77	x	2.4	x	94.68	x	0.3	x	0.7	=	33.07	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	2.4	x	45.59	x	0.3	x	0.7	=	15.92	(80)
West	0.9x	0.77	x	2.4	x	24.49	x	0.3	x	0.7	=	8.55	(80)
West	0.9x	0.77	x	2.4	x	16.15	x	0.3	x	0.7	=	5.64	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	81.97	136.44	178.8	209.34	224.06	218.05	212.03	201.6	189.4	148.61	97.59	70.55

(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	509.11	564.07	595.27	604.54	598.28	570.35	548.1	542.65	539.2	519.55	494.93	487.31

(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(86)m=	0.99	0.97	0.92	0.8	0.63	0.44	0.32	0.33	0.51	0.79	0.96	0.99

(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.71	20.81	20.91	20.98	21	21	21	21	21	20.99	20.86	20.69

(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.52	20.52	20.52	20.53	20.54	20.55	20.55	20.55	20.54	20.54	20.53	20.53

(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.96	0.91	0.77	0.6	0.41	0.28	0.3	0.48	0.76	0.95	0.99

(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	20.17	20.31	20.43	20.52	20.53	20.55	20.55	20.55	20.54	20.52	20.38	20.16	(90)

fLA = Living area ÷ (4) = 0.19 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.27	20.4	20.52	20.61	20.62	20.63	20.63	20.64	20.63	20.61	20.47	20.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.27	20.4	20.52	20.61	20.62	20.63	20.63	20.64	20.63	20.61	20.47	20.26	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.91	0.78	0.6	0.42	0.29	0.31	0.48	0.77	0.95	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	501.83	542.8	538.98	468.82	361.58	238.32	159.33	166.37	260.75	399.47	471.22	482.05	(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=	676.83	653.38	587.91	477.88	362.29	238.33	159.33	166.37	260.8	406.5	548.95	666.43	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	130.2	74.31	36.4	6.52	0.53	0	0	0	0	5.23	55.96	137.18	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 446.34 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	130.2	74.31	36.4	6.52	0.53	0	0	0	0	5.23	55.96	137.18	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 446.34 (98)

Space heating requirement in kWh/m²/year 5.32 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating	**kWh/year**	
Annual space heating requirement	446.34	
Space heat from Community heat pump (98) x (304a) x (305) x (306) =	468.66	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0	(308

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Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2375.33	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2494.1	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	29.63	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		179.13	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	179.13	(331)
Energy for lighting (calculated in Appendix L)		131.91	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-1065.79	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14 =	100.48	(367)
Electrical energy for heat distribution	[(313) x		0.14 =	4.03	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	104.51	(373)
CO2 associated with space heating (secondary)	(309) x		0 =	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14 =	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			104.51	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14 =	24.36	(378)
CO2 associated with electricity for lighting	(332))) x		0.14 =	17.94	(379)
Energy saving/generation technologies (333) to (334) as applicable					
Item 1			0.14 x 0.01 =	-144.95	(380)
Total CO2, kg/year	sum of (376)…(382) =			1.86	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			0.02	(384)
EI rating (section 14)				99.98	(385)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 10 **Software Version:** Version: 1.0.0.37

Property Address: Bath Road 2BF TOP 87 Heat Pump

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	87.3	(1a) x	2.5	(2a) =	218.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	87.3	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		218.25	(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)
-chimneys/flues attached to closed fire	0	+	0	+	0	=	0	x 10 =	0	(6c)
-flues attached to solid fuel boiler	0	+	0	+	0	=	0	x 20 =	0	(6d)
-flues attached to other heater	0	+	0	+	0	=	0	x 35 =	0	(6e)
Number of blocked chimneys							0	x 20 =	0	(6f)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs, etc.	[(6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c)] ÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.13	(21)

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Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m												
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.27	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.2	x1/[1/(1.2)+ 0.04] =	1.37			(27)
Windows Type 2			3.6	x1/[1/(1.2)+ 0.04] =	4.12			(27)
Windows Type 3			2.4	x1/[1/(1.2)+ 0.04] =	2.75			(27)
Windows Type 4			5.04	x1/[1/(1.2)+ 0.04] =	5.77			(27)
Walls	48.67	19.68	28.99	x 0.15 =	4.35			(29)
Roof	87.3	0	87.3	x 0.1 =	8.73			(30)
Total area of elements, m²			135.98					(31)
Party wall			57.4	x 0 =	0			(32)
Party floor			87.3					(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.61 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16349.4 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K — 8.46 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 44.07 (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=	19.56	19.33	19.1	17.95	17.72	16.57	16.57	16.34	17.03	17.72	18.18	18.64	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	63.63	63.4	63.17	62.02	61.79	60.64	60.64	60.41	61.1	61.79	62.25	62.71	

Average = Sum(39)$_{1...12}$ /12= 61.96 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.73	0.73	0.72	0.71	0.71	0.69	0.69	0.69	0.7	0.71	0.71	0.72	

Average = Sum(40)$_{1...12}$ /12= 0.71 (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 — 2.59 (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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

(42a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

(42b)m=	0.78	0.77	0.77	0.74	0.73	0.71	0.7	0.71	0.72	0.74	0.78	0.81	

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

(42c)m=	43.29	41.71	40.14	38.56	36.99	35.42	35.42	36.99	38.56	40.14	41.71	43.29	

Annual average hot water usage in litres per day Vd,average (from Appendix J) — 118.82 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

(44)m=	44.06	42.48	40.9	39.31	37.72	36.13	36.12	37.7	39.29	40.88	42.49	44.09	

Total = Sum(44)$_{1...12}$ = 481.18 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

(45)m=	186.59	166.44	175.23	153.56	149.68	130.76	120.57	135.34	134.4	155.15	170.74	185.34	

Total = Sum(45)$_{1...12}$ = 1863.8 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	27.99	24.97	26.28	23.03	22.45	19.61	18.09	20.3	20.16	23.27	25.61	27.8	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 180 (47)

If Heat network and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 1.2 (48)

Temperature factor from Table 2b — 0.6 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.72	(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 Heat network 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)		0.72	(55)

Water storage loss calculated for each month (56)m = (55) × (41)m (56)m = (55) × (41)m

(56)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m x [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable)

(57)m=	22.32	20.16	22.32	21.6	22.32	21.6	22.32	22.32	21.6	22.32	21.6	22.32	(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=	232.18	207.61	220.81	197.67	195.26	174.87	166.15	180.92	178.51	200.73	214.85	230.93	(62)

WWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating

(63a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution to water heating) (NOT IMPLEMENTED)

(63b)m=													(63b)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

(63c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63c)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

(63b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63b)

Output from water heater

(64)m=	232.18	207.61	220.81	197.67	195.26	174.87	166.15	180.92	178.51	200.73	214.85	230.93	

Output from water heater (annual)$_{1...12}$ 2400.5 (64)

if (64)m < 0 then set to 0

(64a)m=	0	0	0	0	0	0	0	0	0	0	0	0	

Energy

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m] Total per year (kWh/year) = Sum(64a)$_{1...12}$ 0 (64a)

(65)m=	98.51	88.28	94.73	86.35	86.24	78.77	76.56	81.47	79.98	88.05	92.06	98.09	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from Heat network

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=	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	129.35	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	7.37	6.54	5.32	4.03	3.01	2.54	2.75	3.57	4.79	6.09	7.1	7.57	(67)

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	234.02	236.45	230.33	217.3	200.86	185.4	175.08	172.65	178.77	191.79	208.24	223.7	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	35.93	(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=	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	-103.48	(71)

Water heating gains (Table 5)

(72)m=	132.4	131.36	127.32	119.93	115.91	109.4	102.9	109.5	111.08	118.35	127.86	131.85	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	435.6	436.16	424.78	403.06	381.58	359.15	342.52	347.52	356.44	378.04	405.01	424.92	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x 0.77	x	2.4	x	10.63	x	0.5	x	0.7	=	12.38	(74)
North	0.9x 0.77	x	5.04	x	10.63	x	0.5	x	0.7	=	26	(74)
North	0.9x 0.77	x	2.4	x	20.32	x	0.5	x	0.7	=	23.66	(74)
North	0.9x 0.77	x	5.04	x	20.32	x	0.5	x	0.7	=	49.68	(74)
North	0.9x 0.77	x	2.4	x	34.53	x	0.5	x	0.7	=	40.2	(74)
North	0.9x 0.77	x	5.04	x	34.53	x	0.5	x	0.7	=	84.42	(74)
North	0.9x 0.77	x	2.4	x	55.46	x	0.5	x	0.7	=	64.57	(74)
North	0.9x 0.77	x	5.04	x	55.46	x	0.5	x	0.7	=	135.61	(74)
North	0.9x 0.77	x	2.4	x	74.72	x	0.5	x	0.7	=	86.99	(74)
North	0.9x 0.77	x	5.04	x	74.72	x	0.5	x	0.7	=	182.67	(74)
North	0.9x 0.77	x	2.4	x	79.99	x	0.5	x	0.7	=	93.12	(74)
North	0.9x 0.77	x	5.04	x	79.99	x	0.5	x	0.7	=	195.56	(74)
North	0.9x 0.77	x	2.4	x	74.68	x	0.5	x	0.7	=	86.94	(74)
North	0.9x 0.77	x	5.04	x	74.68	x	0.5	x	0.7	=	182.58	(74)
North	0.9x 0.77	x	2.4	x	59.25	x	0.5	x	0.7	=	68.98	(74)
North	0.9x 0.77	x	5.04	x	59.25	x	0.5	x	0.7	=	144.85	(74)
North	0.9x 0.77	x	2.4	x	41.52	x	0.5	x	0.7	=	48.34	(74)
North	0.9x 0.77	x	5.04	x	41.52	x	0.5	x	0.7	=	101.5	(74)
North	0.9x 0.77	x	2.4	x	24.19	x	0.5	x	0.7	=	28.16	(74)
North	0.9x 0.77	x	5.04	x	24.19	x	0.5	x	0.7	=	59.14	(74)
North	0.9x 0.77	x	2.4	x	13.12	x	0.5	x	0.7	=	15.27	(74)
North	0.9x 0.77	x	5.04	x	13.12	x	0.5	x	0.7	=	32.07	(74)
North	0.9x 0.77	x	2.4	x	8.86	x	0.5	x	0.7	=	10.32	(74)
North	0.9x 0.77	x	5.04	x	8.86	x	0.5	x	0.7	=	21.67	(74)

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West	0.9x	0.77	x	1.2	x	19.64	x	0.3	x	0.7	=	3.43	(80)
West	0.9x	0.77	x	3.6	x	19.64	x	0.3	x	0.7	=	10.29	(80)
West	0.9x	0.77	x	1.2	x	38.42	x	0.3	x	0.7	=	6.71	(80)
West	0.9x	0.77	x	3.6	x	38.42	x	0.3	x	0.7	=	20.13	(80)
West	0.9x	0.77	x	1.2	x	63.27	x	0.3	x	0.7	=	11.05	(80)
West	0.9x	0.77	x	3.6	x	63.27	x	0.3	x	0.7	=	33.15	(80)
West	0.9x	0.77	x	1.2	x	92.28	x	0.3	x	0.7	=	16.12	(80)
West	0.9x	0.77	x	3.6	x	92.28	x	0.3	x	0.7	=	48.35	(80)
West	0.9x	0.77	x	1.2	x	113.09	x	0.3	x	0.7	=	19.75	(80)
West	0.9x	0.77	x	3.6	x	113.09	x	0.3	x	0.7	=	59.25	(80)
West	0.9x	0.77	x	1.2	x	115.77	x	0.3	x	0.7	=	20.22	(80)
West	0.9x	0.77	x	3.6	x	115.77	x	0.3	x	0.7	=	60.65	(80)
West	0.9x	0.77	x	1.2	x	110.22	x	0.3	x	0.7	=	19.25	(80)
West	0.9x	0.77	x	3.6	x	110.22	x	0.3	x	0.7	=	57.74	(80)
West	0.9x	0.77	x	1.2	x	94.68	x	0.3	x	0.7	=	16.53	(80)
West	0.9x	0.77	x	3.6	x	94.68	x	0.3	x	0.7	=	49.6	(80)
West	0.9x	0.77	x	1.2	x	73.59	x	0.3	x	0.7	=	12.85	(80)
West	0.9x	0.77	x	3.6	x	73.59	x	0.3	x	0.7	=	38.55	(80)
West	0.9x	0.77	x	1.2	x	45.59	x	0.3	x	0.7	=	7.96	(80)
West	0.9x	0.77	x	3.6	x	45.59	x	0.3	x	0.7	=	23.88	(80)
West	0.9x		x		x		x		x		=		(80)
West	0.9x	0.77	x	3.6	x	24.49	x	0.3	x	0.7	=	12.83	(80)
West	0.9x	0.77	x	1.2	x	16.15	x	0.3	x	0.7	=	2.82	(80)
West	0.9x	0.77	x	3.6	x	16.15	x	0.3	x	0.7	=	8.46	(80)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	52.1	100.18	168.82	264.64	348.66	369.55	346.51	279.96	201.24	119.15	64.45	43.28	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	487.69	536.34	593.6	667.7	730.24	728.7	689.03	627.48	557.69	497.19	469.46	468.19	(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	0.93	0.76	0.53	0.39	0.44	0.73	0.96	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.23	20.35	20.56	20.82	20.97	21	21	21	20.98	20.78	20.47	20.22	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.32	20.32	20.33	20.33	20.35	20.35	20.35	20.34	20.33	20.33	20.32	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.91	0.71	0.48	0.33	0.38	0.67	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

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(90)m=	19.41	19.56	19.82	20.15	20.31	20.34	20.35	20.35	20.33	20.11	19.72	19.39	(90)

fLA = Living area ÷ (4) = 0.2 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.57	19.72	19.97	20.29	20.44	20.48	20.48	20.48	20.46	20.25	19.87	19.56	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.57	19.72	19.97	20.29	20.44	20.48	20.48	20.48	20.46	20.25	19.87	19.56	(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	0.91	0.72	0.49	0.34	0.39	0.68	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	486.16	532.62	580.47	604.88	524.54	355.62	235.13	246.35	380.79	470.52	465.7	467.07	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	971.87	939.57	851.02	706.44	540.22	356.38	235.17	246.47	388.68	596.1	794.94	963.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(97a)m=	361.36	273.47	201.29	73.13	11.66	0	0	0	0	93.43	237.05	369.21	

Total per year (kWh/year) = Sum(97a)$_{1...5,9...12}$ = 1620.6 (97a)

Solar space heating calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to space heating)

(97b)m=	0												

Total per year (kWh/year) = Sum(97b)$_{1...5,9...12}$ = 0 (97b)

Space heating requirement for each month after solar contribution, kWh/month (98)m = (97a)m + (97b)m

(98)m=	361.36	273.47	201.29	73.13	11.66	0	0	0	0	93.43	237.05	369.21	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1620.6 (98)

Space heating requirement in kWh/m²/year 18.56 (99)

9b. Energy requirements – Heat network scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 1 (303a)

Fraction of total space heat from Community heat pump (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for Heat network system 1 (305)

Distribution loss factor (Table 12c) for Heat network system 1.05 (306)

Space heating		**kWh/year**	
Annual space heating requirement		1620.6	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	1701.63	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308

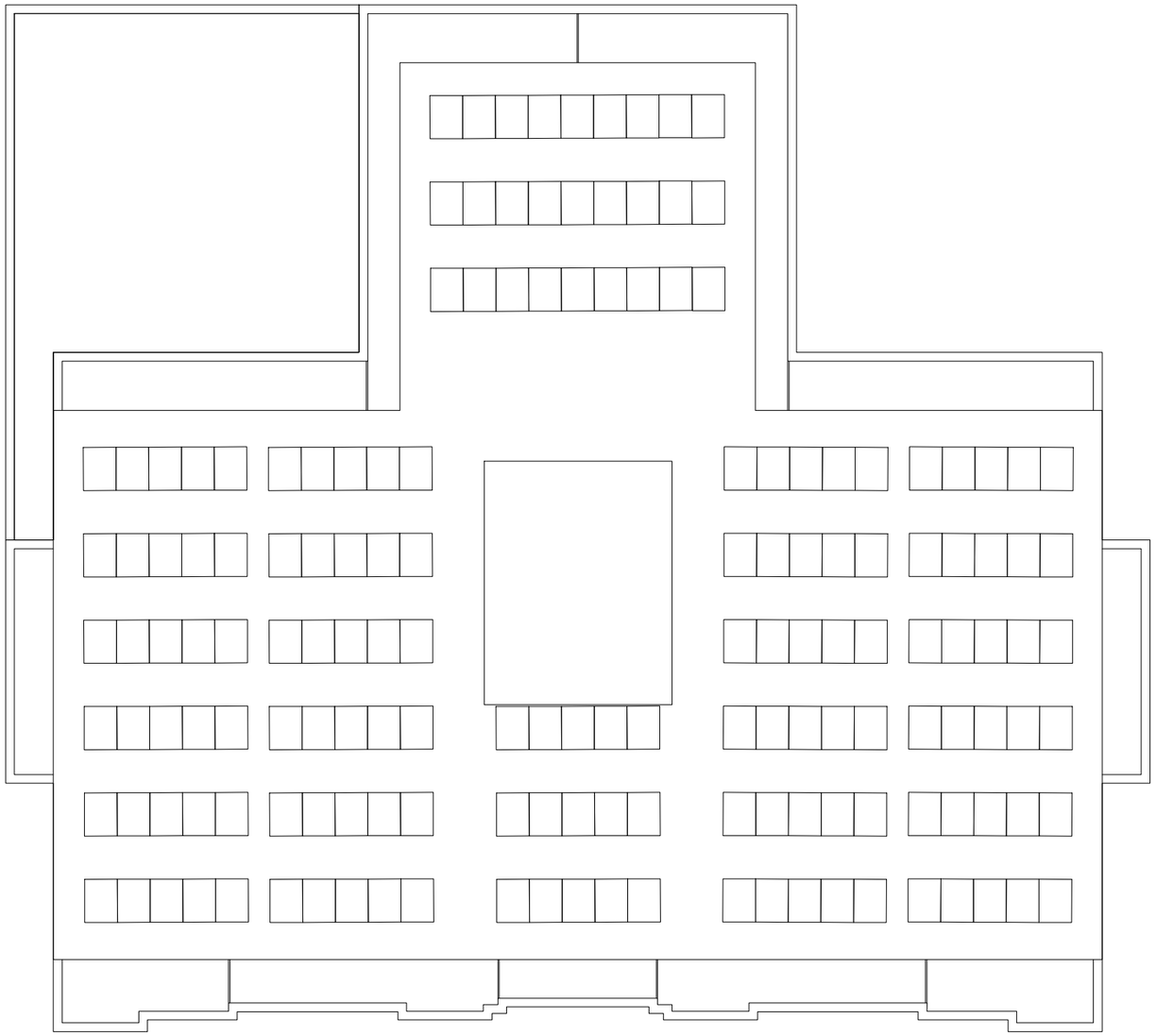
DER WorkSheet: New dwelling design stage

Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2400.5	
If DHW from community scheme:			
Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	2520.52	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	42.22	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		186.39	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	186.39	(331)
Energy for lighting (calculated in Appendix L)		130.09	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-1108.99	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Heat network scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				401	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.14	=	143.2	(367)
Electrical energy for heat distribution	[(313) x		0.14	=	5.74	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	148.94	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.14	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				148.94	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.14	=	25.35	(378)
CO2 associated with electricity for lighting	(332))) x		0.14	=	17.69	(379)
Energy saving/generation technologies (333) to (334) as applicable						
Item 1			0.14	x 0.01 =	-150.82	(380)
Total CO2, kg/year	sum of (376)…(382) =				41.16	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				0.47	(384)
EI rating (section 14)					99.58	(385)

Appendix 3 – Roof Plan showing Indicative Location of Photovoltaic Panels



Rev	Date	Description

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Proposed Roof Plan

0 2 4 6 8

Scale	Dwg No.
1:200 @ A3	FLU.1347.13
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