SYNTEGRA CONSULTING

Energy Strategy Report

14-1230

35 York Way,

London,

N7 9QF

November 2016

Rev C

Quality Standards Control

The signatories below verify that this document has been prepared in accordance with our quality control requirements. These procedures do not affect the content and views expressed by the originator.

Revision	*Rev A*	*Rev B*	*Rev C*	
Date	18/10/2016	10/11/2016	15/11/2016	
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1. Addendum 1 – Response to Council Comments 1st November 2016

Table A below summarises the proposed development's design principles in relation to the Council's policy DP22 as requested by the Local Authority on 1st November 2016 following the submission of Rev A of this report dated 18th October 2016.

Design Principles	Project Response
	Design
The layout of uses	The apartments have been configured to ensure that the living spaces open out on to terraces facing away from York way to minimise acoustic issues and maximise air quality to the apartment. The apartments have been designed to provide multi-lateral fenestration to maximise daylight throughout the day with all apartments befitting from a minimum of glazing to 3 facades.
Floorplates size/depth	The floor plates have been designed at depths which will maximise cross ventilation and allow natural light deep into the plan forms from a minimum of 3 facades per apartment.
Floor to ceiling heights	The apartments have been designed to provide floor to ceiling heights of 2.4m which provides a balance between visually positive spaces and environments which are economical to heat and ventilate.
Location, size and depth of windows	The majority of glazing can be seen on the eastern façade where mostly bedrooms have been allocated allowing the benefit of morning sun to be used by occupants as well as evening sun in the living rooms. Additionally, the average glazing ratio for the dwellings is 15% which is near the advised value to benefit from solar gains and natural lighting but reducing the risk of overheating through excessive solar gains.
Limiting excessive solar gain	The majority of glazing is on the eastern and western façade. This along with the room allocation (mentioned above) allows the habitable areas to be warmed at a comfortable level at beneficial times of the day. Additionally, the average glazing ratio for the dwellings is 15% which is near the advised value to benefit from solar gains and natural lighting but reducing the risk of overheating through excessive solar gains. Please refer to Section 7.1 mon page 19 for more detail
Reducing the need for artificial lighting	The majority of glazing is on the eastern and western façade. This along with the room allocation (mentioned above) allows the habitable areas to be warmed at a comfortable level at beneficial times of the day. Additionally, the average glazing ratio for the dwellings is 15% which is near the advised value to benefit from solar gains and natural lighting but reducing the risk of overheating through excessive solar gains. Please refer to Section 7.1 mon page 19 for more detail
Shading methods, both on or around the building	Due to the window areas, room depths and orientation the dwellings do not require a large amount of shading other than what is provided by surrounding structures.
Optimising natural ventilation	All windows are openable and cross ventilation possible. As such the required air change rate for a comfortable area is provided. Please refer to Section 7.1 on page 20 for more detail
Design for an inclusion of renewable energy technologies	It has been proposed that a roof top Photovoltaic array of 6.75kWp total capacity be provided for the dwellings. See the Be Green Section (9.2) on page 30 for more detail.

Design Principles	Project Response
Impact on existing renewable and low carbon technologies in the area	The proposed development does not exceed the surrounding areas height therefore no additional shading will be caused by the development. It is unknown what existing technology is installed in the area.
Sustainable urban drainage including provision of a green and/or brown roof	It is currently proposed that drainage be provided by the existing system, however this will be reviewed post planning.
Adequate storage space for recyclable materials, composting where possible	Dedicated bin stores (including separate stores for recycling and refuse) will be provided within screened storage areas within the amenity space of the development within easy access of the apartment entrance. Sufficient space as well as access will be provided to meet the council's allocation requirements.
Bicycle storage	'Sheffield' style bicycle stands are proposed and are to be housed within a covered cycle store. A total of 16 no. stands are to be provided. The dimensions of the cycle store can be seen on the drawing below. The dimensions are aligned with the requirements set out in Camden Planning Guidance 7 – Transport. 
Measures to adapt to climate chance	The development utilises the following: • natural ventilation through openable windows • new landscaping with biodiverse planting on an area which is currently completed hard landscaped • all new hard landscaping will be permeable
Impact on microclimate	The proposed design will have either a natural or positive impact on the microclimate
Fabric/Services	
Level of insulation	Insulation and material use has been considered to ensure fabric efficiency is enhanced where possible. The targeted U-Values at this stage in design are far better than minimum levels required by Part L 2013 of Building Regulations. Please refer to Section 7.1 on page 19 for more detail

Design Principles	Project Response
Choice of materials, including – responsible sourcing, re-use and recycled content	The Applicant will endeavour to source materials from suppliers who participate in responsible sourcing schemes such as the BRE BES 6001:2008 Responsible Sourcing Standard. Where possible timber will be sourced from schemes supported by the Central Point of Expertise for Timber Procurement such as Forest Stewardship Council (FSC) accreditation (which ensures that the harvest of timber and non-timber products maintains the forest's ecology and its long-term viability).
Air tightness	The proposed design is targeting a maximum air tightness of $4m^3/m^2h$ @50Pa, which is better than minimum requirements set by Part L 2013 of Building Regulations.
Efficient heating, cooling and lighting systems	It is currently proposed that space heating and domestic hot water is provided by efficient individual gas boilers (90% efficiency). No cooling has been design at this stage based on the design as comfort levels are met by natural ventilation and non-excessive solar gains. 100% LED lighting will be used throughout the development. See Section 7.2 on page 20 for more detail.
Effective building management systems	No Building Management Systems will be required for this development apart from landlord/communal areas of which the demand will be small. It is assumed that dwellings will be controlled by the residents individually.
Source of energy used	Mains gas will be used for space heating and domestic hot water with electricity demand coming from lighting and auxiliary uses. It is expected that the main demand will be for gas.
Metering	Each dwelling will be metered individually for utilities. Smart meters will also be considered for occupants as they are being made available by utility companies
Counteracting the heat expelled from plant equipment	All plant will be fully insulated to avoid waste heat from plant. Additionally, there will be no plant space as such due to local systems rather than communal.
Enhancement of/provision for biodiversity	There is currently no soft landscaping on the existing site making the ecological value very low. The proposed development includes a new landscaped area including planting and green space. Local habitat friendly species will be preferred for these areas.
Efficient water use	It is proposed that the dwellings will be specified with low flow rate and consumption fittings. Targeted values have been set and can be found in the appendix of this report (Addendum dated 02/11/16 – Water Consumption)
Re-use of water	Where feasible rainwater will be collected and used for irrigation of the landscaped areas, e.g. the provision of water butts.
Educational elements, e.g. visible meters	Each dwelling will be metered individually for utilities. Smart meters will also be considered for occupants as they are being made available by utility companies
On-going management and review	It is currently unknown on the tenure of these developments and will be discussed post planning.

2. Executive Summary

This Energy Statement demonstrates the predicted energy performance and carbon dioxide emissions of the proposed development at, **35 York Way, London N7 9QF** based on the information provided by the design team. The development will comprise of the **new construction of 9 flats within the London Borough of Camden.**

2.1. Policy Requirements

The Council requires new developments to incorporate sustainable design and construction measures. The table below summarises the local policy requirements for the proposed development.

Policies	Requirements	Notes
London Plan 5.2 Policy DM10	An overall 35% reduction of carbon emissions over the Building Regulation Part L 2013.	The development can demonstrate through the proposed strategy that an improvement of 35.4% can be achieved, therefore the policy requirement has been met
Policy DM11	A 20% carbon reduction via on-site renewable technologies	Through the installation of 6.75kWp of rooftop photovoltaic (PV) panels an improvement of 25.1% carbon emissions from on-site renewable technologies can be demonstrated. Therefore the policy requirement has been met
Policy DM13	Code for Sustainable Home (CSH) Level 4	As CSH was withdrawn by the government as of April 2015, a pre-assessment has not been provided as part of this report.

Table 1 Policy Requirements

2.2. Methodology and Strategies

The methodology used to determine the CO_2 emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2). The below table shows the Energy Hierarchy and suggested strategies for the proposed development.

Stages	Strategies
BE LEAN Energy efficient design	• U-values better than Building Regulations Part L. • Accredited Construction Details for all junctions • High efficient individual gas combi boilers for heating and hot water demand • Natural ventilation with extract fans in wet rooms • Low energy lights
BE CLEAN District heat networks or communal heating systems	Communal heating was not seen as a feasible heating option for this development due to unavailability of plant space and the site is not within reasonable proximity to existing or potential district heat networks.

BE GREEN On-site renewable technologies	• PV panels of 6.75kWp on the roof (approximate 27 panels with 250 w/p were used to demonstrate this at this stage of design).

Table 2 Energy Hierarchy and suggested strategies

2.3. Assessment Results

After the application of all strategies based on the Energy Hierarchy, the regulated carbon dioxide emissions have been reduced as follows;

Energy Hierarchy		Carbon Emissions (Tonnes CO_2/yr)
		Regulated
BASELINE	TER set by Building Regulations 2013 Part L	13.99
BE LEAN	After energy demand reduction	12.06
BE CLEAN	After CHP/ Communal Heating	12.06
BE GREEN	After renewable energy	9.03

Table 3 Carbon Emissions after each stage of the proposed strategy

This carbon savings from each stage can be calculated based on the results above. The chart below summarises the total cumulative savings and the Carbon Offset Fund contribution based on the shortfall:

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO_2/yr	%
BE LEAN	After energy demand reduction	1.93	13.8 %
BE CLEAN	After heat network/ CHP	-	-
BE GREEN	After renewable energy	3.03	25.1 %
Total Cumulative Savings		**4.96**	**35.4%**
Total Target Savings		4.90	35 %
Shortfall		-0.06	-0.4%
Carbon Offset Fund		**£0**	

Table 4 Carbon dioxide Emissions after each stage of the Energy Hierarchy

The table above demonstrates that the requirements of the London Plan and Local Policy DM10 to achieve a 35% carbon reduction have been met, i.e. and improvement of >35% carbon emissions over the Part L 2013 baseline and 20% carbon offset from on-site renewable technologies. Therefore, a payment into **the Carbon Offset Fund** is not required to satisfy council requirements, in accordance with GLA guidance on preparing energy assessments adopted March 2016.

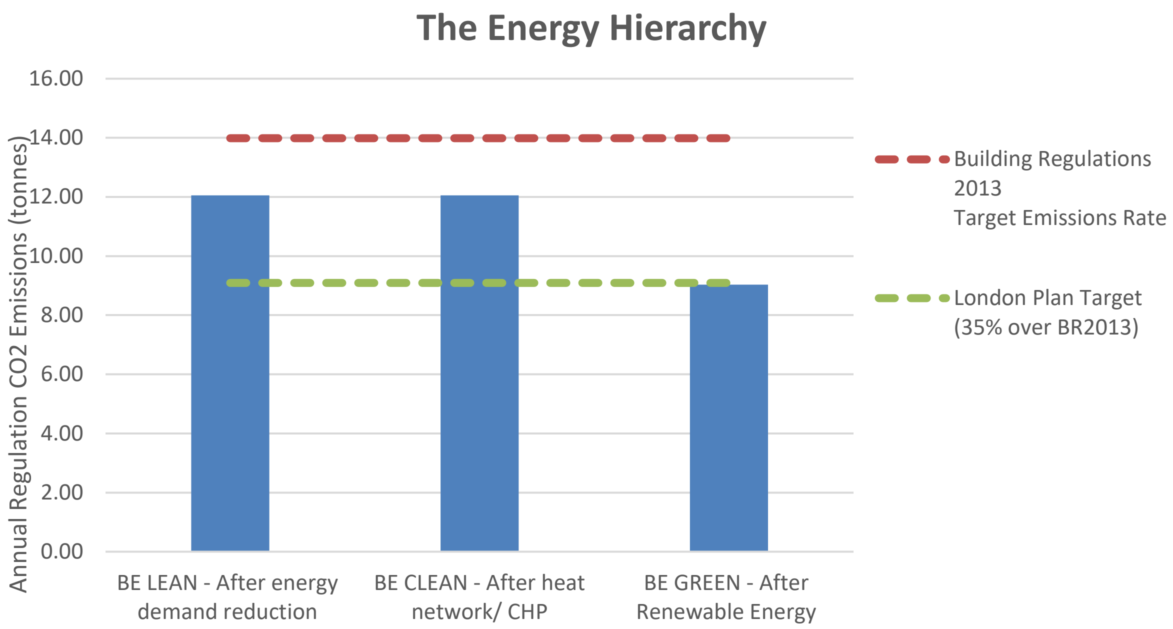


Figure 1 The Energy Hierarchy

3. Introduction

This Energy Statement will be included as part of the planning application that addresses the environmental impact of the development. This report focuses on the energy strategy for the proposed scheme and how energy consumption and carbon emissions will be minimised and to meet the targeted carbon emissions in accordance with the London Plan and Local planning policy.

The development is to be located in the **London Borough of Camden** and it is in close proximity to bus stops for the 274 and the 390, Camden Road overground Station (approx. 0.6 miles) and Caledonian Road & Barnsbury Overground Station (approx. 0.6 miles). The proposal is **new construction of a 4 storey building comprising of 9 no. of residential units.**

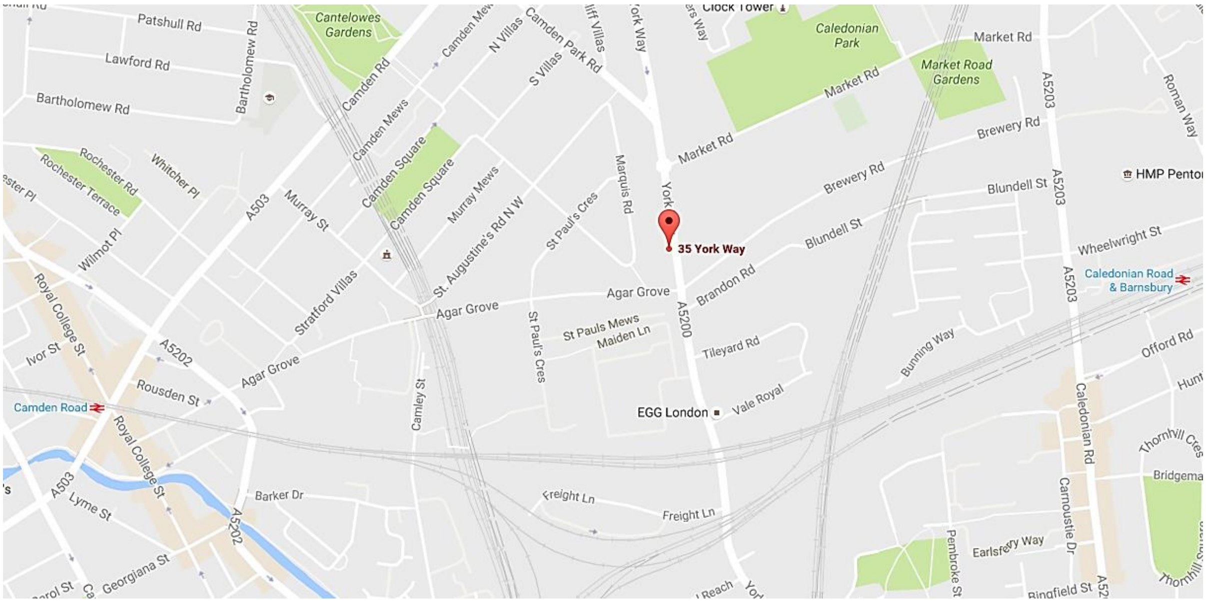


Figure 2 Site Location

The following table presents the type, area and number of units to be assessed within this report.

NEW CONSTRUCTION				
Type	**Name of unit**	**Floor**	**No. of Bedrooms**	**Net Internal Floor Area** (m^2)
Residential	Flat 1	Ground Floor	2	93.10
	Flat 2	Ground Floor	1	50.11
	Flat 3	Ground Floor	1	54.43
	Flat 4	1st Floor	2	94.62
	Flat 5	1st Floor	4	108.62
	Flat 6	2nd Floor	3	94.61
	Flat 7	2nd Floor	3	91.09
	Flat 8	3rd Floor	2	80.00
	Flat 9	3rd Floor	2	70.80
Total	-	-	-	**737.38**

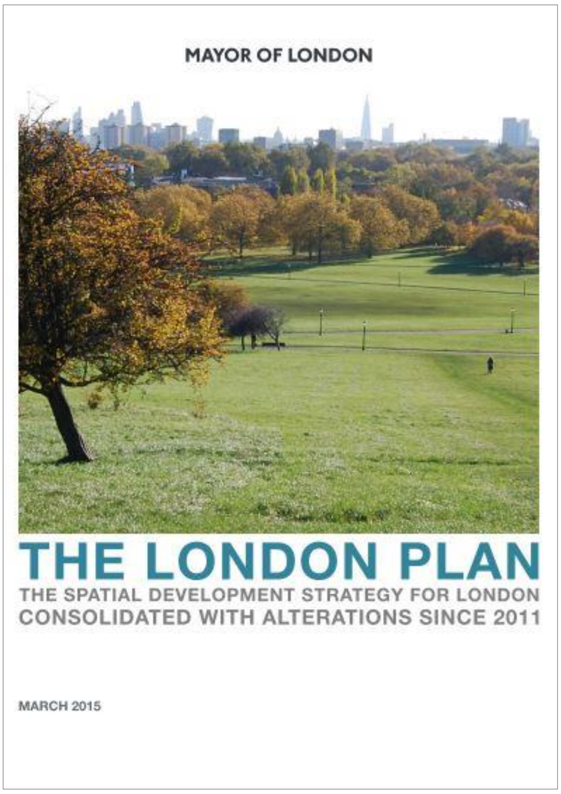
Table 5 Proposed units to be assessed for the development

4. Planning Policy

4.1. National Planning Policy Framework (March 2012)

The National Planning Policy Framework is a key part of our reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

4.2. The London Plan – The Spatial Development Strategy for London Consolidated with Alterations Since 2011 (March 2015)



Policy 5.2, 5.4, 5.5, 5.6, & 5.7

According to Policy 5.2 all major new developments should show an improvement of 35% from 2013 to 2016 over 2013 Building Regulations, unless it can be demonstrated that such provision is not feasible. For retrofitting developments, it will be a challenge to meet these target. However, available reductions in carbon emissions should be demonstrated along with water saving measures as per Policy 5.4.

Furthermore, intent must be shown for connecting to a Decentralised Energy Network and utilizing a Combined Heat & Power according to Policy 5.5 and 5.6. The Mayor and boroughs should in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from onsite renewable energy generation according to paragraph 5.42 of Policy 5.7 Renewable Energy.

4.3. London Borough of Camden

Camden

Camden Development Policies 2010-2025

Policy DP22: Promoting Sustainable Design and Construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a. demonstrate how sustainable development principles, have been incorporated into the design and proposed implementation; and
b. Incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c. expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and **encouraging Code Level 6 (zero carbon) by 2016.**;
d. expecting developments (except new build) of 500sqm of residential floor space or above or 5 or more dwellings to achieve 'very good' in EcoHomes assessments prior to 2013 and encouraging 'excellent' from 2013;
e. Expecting non-domestic developments of 500sqm of floor space or above to achieve 'very good' in BREEAM assessments and 'excellent' from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f. summer shading and planting;
g. limiting run-off;
h. reducing water consumption;
i. reducing air pollution; and
j. Not locating vulnerable uses in basements in flood-prone areas.

Policy DP23: Water

The Council will require developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

a) incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;
b) limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined in part a) and other sustainable urban drainage methods to reduce the risk of flooding;
c) reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface

water flooding are designed to cope with the potential flooding;
d) ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and
e) Encouraging the provision of attractive and efficient water features.

Camden Core Strategy 2010-2025

Policy CS13 – Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a. ensuring patterns of land use that minimize the need to travel by car and help support local energy networks;
b. promoting the efficient use of land and buildings;
c. minimizing carbon emissions from there development, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
    1. ensuring developments use less energy,
    2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralized energy networks;
    3. generating renewable energy on-site;
d. Ensuring buildings and spaces are designed to cope with, and minimize the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation

The Council will promote local energy generation and networks by:
e. working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of
    - housing estates with community heating or the potential for community heating and other uses with large heating loads;
    - the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
    - schools to be redeveloped as part of Building Schools for the Future programme;
    - existing or approved combined heat and power/local energy networks (see Map4);
    - Other locations where land ownership would facilitate their implementation.

f. protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Water and surface water flooding

We will make Camden a water efficient borough and minimise the potential for surface water flooding by:

g. protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;
h. making sure development incorporates efficient water and foul water infrastructure;
i. requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and downstream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross (see Map 5).

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j. taking measures to reduce its own carbon emissions;
k. trialling new energy efficient technologies, where feasible; and
l. Raising awareness on mitigation and adaptation measures.

Generating renewable energy on-site

13.11 Buildings can also generate energy, for example, by using photovoltaic panels to produce electricity, or solar thermal panels, which produce hot water. Once a building and its services have been designed to make sure energy consumption will be as low as possible and the use of energy efficient sources has been considered, **the Council will expect developments to achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation** (which can include sources of site-related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. Details on ways to generate renewable energy can be found in our Camden Planning Guidance supplementary document.

5. Assessment Methodology

5.1. Mayor's Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary use, to then improving the efficiency of energy systems to minimise loss, this is followed by exploiting renewable energy sources and then low carbon energy solutions for energy needs and finally, any remaining demand can be catered for by conventional fuel sources.

The Mayor's Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. These guiding principles have been reordered since the publication of the Mayor's Energy Strategy in Feb 2004 and the adopted replacement London Plan 2011 with further alterations in 2015 stating that the following hierarchy should be used to assess applications:

- **BE LEAN** – By using less energy and taking into account the further energy efficiency measure in comparison to the baseline building.
- **BE CLEAN** – By supplying energy efficiently. The clean building looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy via CHP.
- **BE GREEN** – By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.

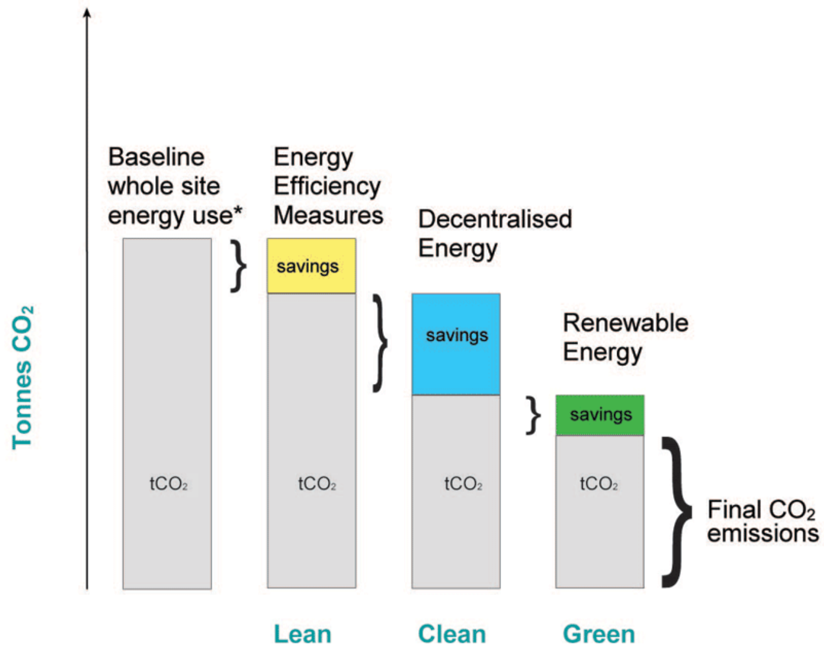


Figure 3 The Energy Hierarchy

5.1. Software and Input data

The Government approved software, i.e. **FSAP 2012** has been utilised to carry out **Standard Assessment Procedure (SAP)** calculations - the SAP for the proposed residential units.

Syntegra received the architectural drawings and relevant documents, and they were used to undertake the energy assessments. The document references are listed in the table below.

No.	Document Name	Received Date
1	12E Proposed Plans 0F+1F	28-04-2016
2	13E Proposed Plans 2F+3F	28-04-2016
3	15D Proposed Elevs East	28-04-2016
4	16C Proposed Elevs West	28-04-2016
5	17D Proposed Elevs North	28-04-2016
6	18D Proposed Elevs South	28-04-2016

Table 6 The document list

6. Baseline – Target Emission Rate

The baseline (known as Target Emission Rate), as calculated in line with the Building Regulation 2013, is the maximum amount of carbon dioxide a dwelling or non-residential unit is allowed to emit. The Target Emission Rate (TER) includes carbon dioxide emissions which are covered by Part L of the Building Regulations, known as regulated emissions (space and water heating, ventilation, lighting, pumps, fans & controls). The baseline energy uses and resulting CO_2 emissions rates of the development have been assessed using the Government approved software.

The baseline regulated CO_2 emissions for the development as a whole are presented in the tables below:

BASELINE

BASELINE: TER		**Regulated CO_2 Emissions** (Tonnes CO_2/yr)
Residential	Flat 1	1.77
	Flat 2	1.07
	Flat 3	1.31
	Flat 4	1.64
	Flat 5	1.74
	Flat 6	1.67
	Flat 7	1.52
	Flat 8	1.80
	Flat 9	1.46
TOTAL		**13.98**

Table 7 Regulated Energy Use and Carbon Emissions at Baseline

7. BE LEAN – Energy Efficient Design

This section outlines the energy efficient measures taken in order to minimise the building's energy demand and therefore reduce energy use and CO_2 emissions further than the Baseline requirements (Building Regulations 2013 Part L compliance).

7.1. Passive Design Measures

- **Enhanced Building Elements**

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the build. The heat loss of different building element is dependent upon their U-value, air tightness, and thermal bridging y-values. Therefore, better U-values and air permeability than the minimum values set in the Part L 2013 have been suggested in this development. And, Accredited Construction Detail for Part L was also applied for all thermal bridging junctions to reduce the heat loss from the thermal bridging. Please see below more specifically:

		Part L 2013 min. required values	Proposed building values
		L1A	
U-value (W/m^2 K)	Wall	0.30	0.13
	Window	2.00	1.1
	Floor	0.25	0.10
	Roof	0.20	0.09
	Door	1.0 (notional)	1.4
Air Permeability ($m^3/h.m^2$ at 50 Pa)		10	4
Use of Accredited Construction Details		YES (thermal bridging calculations have been carried out for residential units based on ACD for Part L)	

Table 8 Proposed Building Elements

- **Orientation & Natural Daylighting**

Passive solar gain reduces the amount of energy required for space heating during the winter months. The building is typically positioned to have east aspect aligned with the roads and also maximise the passive solar gains into the building throughout the day. Moreover, the internal layout of the development has been designed to improve daylighting in all habitable spaces, as a way of improving the health and wellbeing of occupants.

- **Natural Ventilation**

A natural ventilation strategy will be adopted in all residential units **with extract fans in wet rooms**; toilets, kitchen, and utility rooms. Therefore, higher energy consumption and CO_2 emissions due to mechanical ventilation is avoided.

7.2. Active Design Measures

- **Heating and Hot Water System**

The space heating and hot water are provided by energy efficient systems as summarised in the table below. At the 'BE LEAN' stage **High efficiency individual combi gas boilers (90% efficiency) have been examined for space heating and hot water demand in residential units.** The heating control will be time and temperature zone control by suitable arrangement of plumbing and electrical services. The pump will be in heated space and the boiler will be interlocked. Design flow temperature will be ≤45°C. Fuel burning type is On/Off and the fuel type is unknown at the moment. No fan assisted flue has been applied.

Systems	General Specification	Controls
Heating system	Individual Combi gas Boilers (Efficiency of 90%)	• Time and temperature zone control by suitable arrangement from plumbing and TRVs and bypass • Heating Emitter – Underfloor heating (bathrooms) • Heating Emitter – Radiators
Hot water system	Same as space heating	-

Table 9 Heating and Hot water systems

All suggested specifications above are provisional, and have to be reviewed with mechanical engineers and contractors at detailed design stage.

- **High Efficiency Lighting**

The proposed light fittings will be low energy efficient fittings. These can be **T5 fluorescent fittings with high frequency ballasts, or LED fittings for residential units.** The suggested specifications should be reviewed at detailed design stage with electric engineers.

BE LEAN STAGE

		BASELINE	BE LEAN
		CO_2 Emissions (Tonnes CO_2/yr)	CO_2 Emissions (Tonnes CO_2/yr)
Residential	Flat 1	1.77	1.59
	Flat 2	1.07	0.99
	Flat 3	1.31	1.17
	Flat 4	1.64	1.49
	Flat 5	1.74	1.56
	Flat 6	1.67	1.51
	Flat 7	1.52	1.38
	Flat 8	1.80	1.32
	Flat 9	1.46	1.04
TOTAL		**13.98**	**12.06**
Carbon Reduction		**-**	**13.8%**

Table 10 Regulated Energy Use and Carbon Emissions at Be Lean Stage

8. BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of a CHP system and the connection to District Heating system to reduce CO_2 emissions further.

8.1. Decentralised Energy Network

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map Study for the London Borough of Camden** as part of this assessment. The study identifies that the site is not located near the existing district heating networks. This is demonstrated clearly from the London Heat Map (http://www.londonheatmap.org.uk) snapshot below.

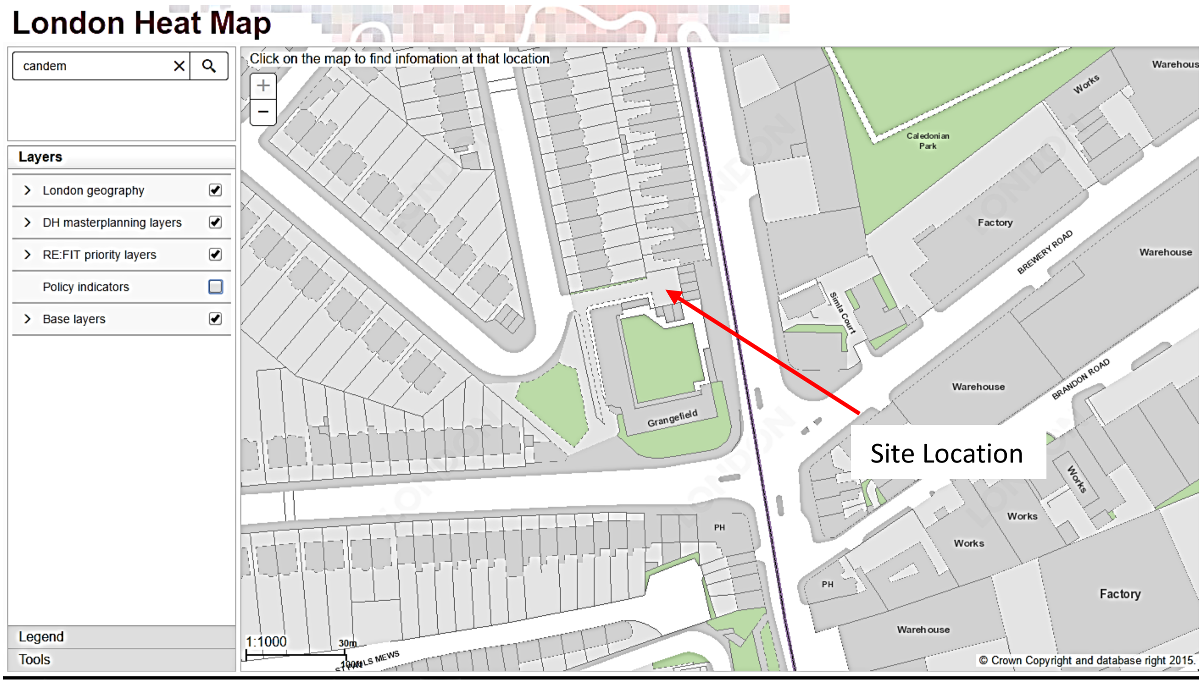


Figure 4 London Heat Map near the site

Moreover, the London heat map below identifies existing DH networks in more broaden area, and it could not find any existing DH networks (in yellow) within 1km radius from the property. The costs involved in extending the existing DH network would outweigh the advantages in this development. **Therefore, utilisation of the DH network has not been a feasible option for this development.**

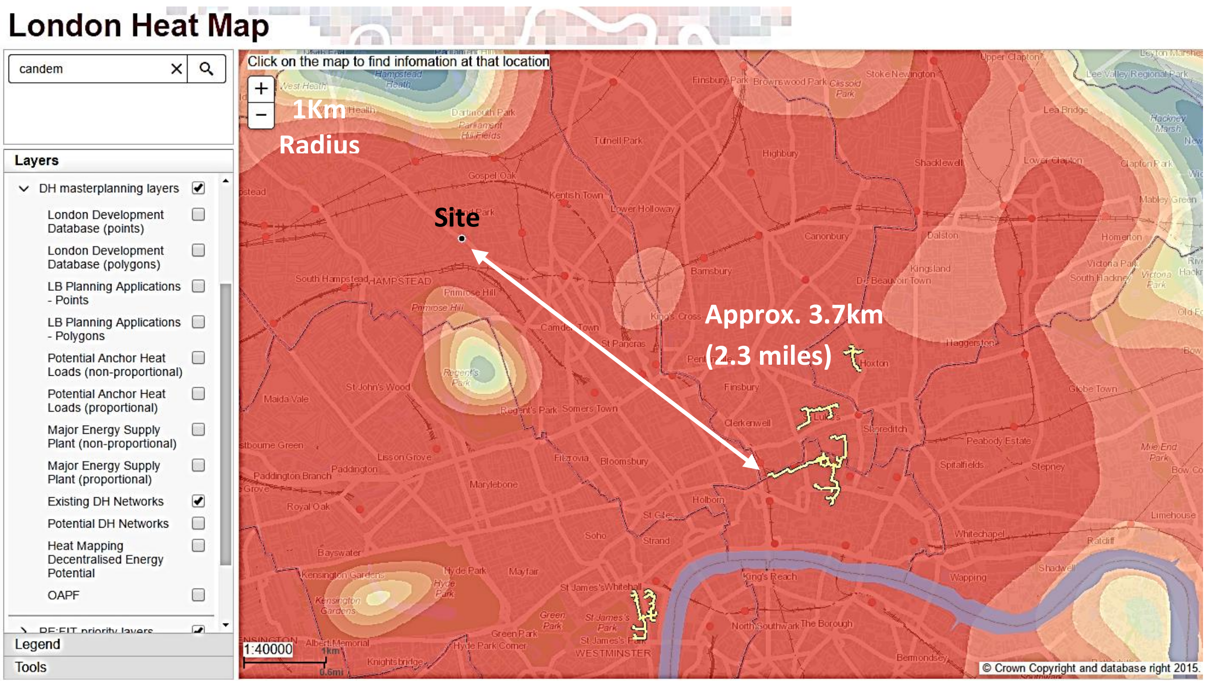


Figure 5 Existing DH Network near the site

However, as can be seen on the map below, there may be a potential DH network passing through near the site at around 1.8 Km from the development site.

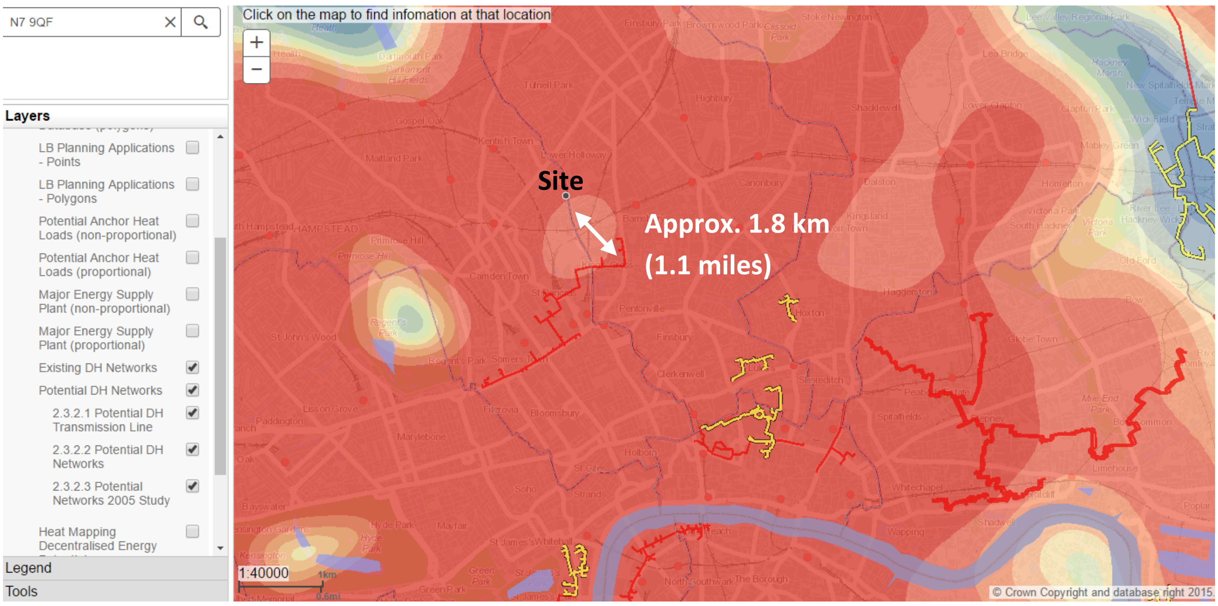


Figure 6 Potential DH Network near the site

8.2. CHP

The Energy Hierarchy identifies the combined heat and power (CHP) as a method of producing heat and electricity with much lower emissions than separate heat and power. Also, it encourages the creation of district heating systems supplied by CHP. The implementation of a CHP strategy should be decided according to good practice design. Key factors for the efficient implementation of the CHP system are:

- Development with high heating load for the majority of the year.
- CHP operation based on maximum heat load for minimum 10 hours per day.
- CHP operation at maximum capacity of 90% of its operating period.

To ensure that CHP is financially viable it is essential that the unit is selected to meet the base heat load and that this load is maintained over a large proportion of the day (a figure of 14 – 17 hours per day is often quoted subject to the load profiles and gas and electricity prices) to ensure that the additional costs (maintenance) associated with running a CHP unit can be recovered. This need to run the CHP plant, as far as possible continuously makes the building load profile of prime importance when reviewing the viability of such solutions and in particular the summer time heat load profile. To enable the CHP plant to run continuously when it is operating, a thermal store is often used so that excess CHP capacity can be used to generate hot water for use at a later time.

The feasibility of installing CHP has been assessed for this development. **Since this development has only 9 residential units that would not create high heating loads, installing the CHP system would not be beneficial given the cost. Moreover, the development does not have enough plant space for the CHP system. Hence a CHP system has not been considered for this development.** Hence, no CO_2 reduction can be achieved at Be Clean stage.

BE CLEAN stage

		BE LEAN	BE CLEAN
		CO_2 Emissions (Tonnes CO_2/yr)	**CO_2 Emissions** (Tonnes CO_2/yr)
Residential	Flat 1	1.59	1.59
	Flat 2	0.99	0.99
	Flat 3	1.17	1.17
	Flat 4	1.49	1.49
	Flat 5	1.56	1.56
	Flat 6	1.51	1.51
	Flat 7	1.38	1.38
	Flat 8	1.32	1.32
	Flat 9	1.04	1.04
TOTAL		**12.06**	**12.06**
Carbon Reduction		**-**	**0.00%**

Table 1111 Regulated Energy Use and Carbon Emissions at Be Clean Stage

9. BE GREEN – Renewable Energy

In this section the viable renewable energy technologies that could reduce the development's CO_2 emissions are examined. In determining the appropriate renewable technology for the site, the following factors were considered;

- Renewable energy resource or fuel availability of the LZC technology on the site.
- Space limitations due to building design and urban location of the site.
- Capital, operating and maintenance cost.
- Planning Permission
- Implementation with regards the overall M&E design strategy for building type
- Available Grants

The table below summarises the various low zero carbon technologies considered for the projects, and we have identified that **Photovoltaic (PV)** would be the most appropriate option in this development. Solar Thermal was also seen as a feasible technology, however due to the individual heating systems the infrastructure required for the solar thermal to be used on site would create additional problems. Additionally, there was a greater carbon offset from PV alone therefore this technology was discounted at this stage.

Technology	Local Planning Requirements	Carbon Payback	Grants/ Funding	Feasibility
Photovoltaic (PV)	Spatial and Shadowing	High	Feed-in Tariff (FIT)	**HIGH**
Air Source Heat Pumps (ASHP)	Noise Issues from External units	High	Renewable Heat Incentive (RHI)	**MEDIUM**
Solar Thermal	Spatial and Shadowing	Low	Renewable Heat Incentive (RHI)	**HIGH**
Ground Source Heat Pumps (GSHP)	Spatial issues for Bore Holes and noise	Medium	Renewable Heat Incentive (RHI)	**LOW**
Biomass	Spatial requirement for fuel storage and biomass odour	High	Renewable Heat Incentive (RHI)	**LOW**
Wind Power	Extensive planning requirements for noise and local biodiversity	Low	Feed-in Tariff (FIT)	**LOW**

Technology	Local Planning Requirements	Carbon Payback	Grants/ Funding	Feasibility
Hydro Power	Extensive planning requirements for noise and water quality	None	Feed-in Tariff (FIT)	**ZERO**

Table 12 Feasibility Study of LZC Technologies

9.1. Non-feasible Technology

- **Ground Source Heat Pumps (GSHP)**

Ground source heat pump would be a feasible option to meet the space heating requirements, however, it requires ground space for bore holes to extract the ground heat to be utilised for space heating requirements. In this case there is no available ground space for a borehole or trench system, the ground source loop would have to be incorporated within the foundation piles of the structure, which would result in additional cost. Hence, this option is not suitable for this development.

- **Solar Thermal**

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Therefore, this system would require additional plumbing and space for hot water storage, incurring additional financial cost. Moreover, the amount of carbon offset from the system is generally lower than other technologies. Therefore, this technology is deemed to be unsuitable for this development.

- **Hydro power**

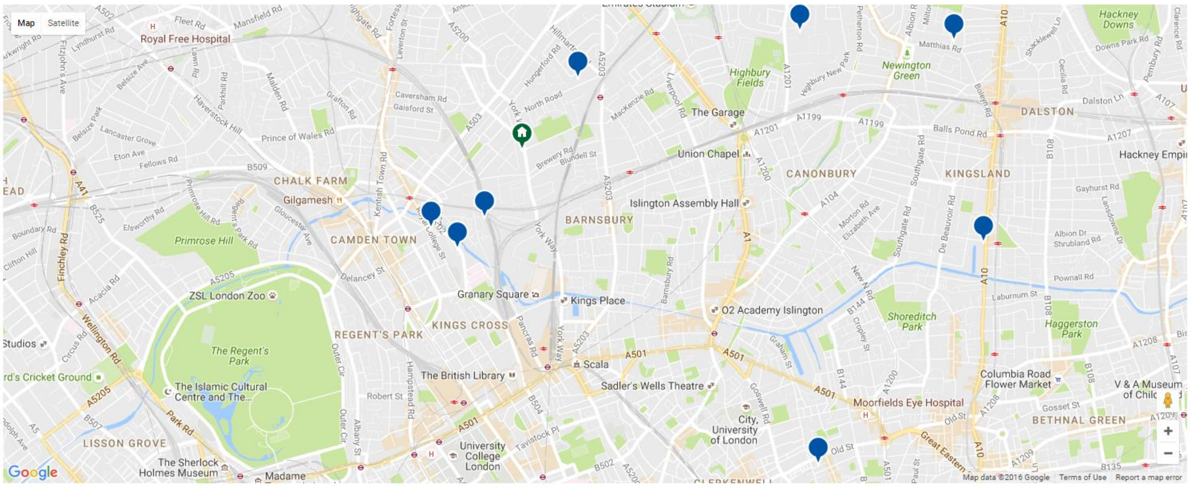
There is no river or lake within the development site boundaries. Therefore, small scale hydro-electric will not be studied any further because of the location and the spatial limitations of the development.

- **Biomass**

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

i. The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
ii. the lack of spaces for pellet boiler and storage on the site.
iii. Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.

However, if the biomass system is considered at detailed design stage, local suppliers can be found near the site as shown in the map below (http://biomass-suppliers-list.service.gov.uk).



Company name	Contact	Fuel Supplied	Telephone
Wolseley UK Ltd	www.pipecenter.co.uk k94.kingscross@wolseley.co.uk	Pellets	0207 3804230
City Plumbing Suppliers (CPS) part of the Travis Perkins Group	www.cityplumbing.co.uk shaun.jackson@cityplumbing.co.uk	Briquettes, Pellets	0207 6973480
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk sean.mahon@travisperkins.co.uk	Pellets	0207 380 6480
Wolseley UK Ltd	www.plumbcenter.co.uk FFP.Camden@wolseley.co.uk	Pellets	0207 4240957
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk toby.duncan@travisperkins.co.uk	Pellets	0207 561 0516
Wolseley UK Ltd	www.plumbcenter.co.uk YM.Highbury@wolseley.co.uk	Pellets	0207 7041830
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk keith.gittins@travisperkins.co.uk	Pellets	020 7251 6999
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk kenneth.walker@travisperkins.co.uk	Pellets	08705 005500
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk kelly.thomson@travisperkins.co.uk	Pellets	020 7254 1200
Travis Perkins Trading Co. Ltd	www.travisperkins.co.uk daniel.marsden@travisperkins.co.uk	Pellets	020 7254 1442

Figure 7 Biomass seller in the development area

- **Wind Power**

Wind turbines need extensive planning requirements and they are only feasible at consistent wind speed. Moreover, since the development is located in an urban area, the site does not have sufficient wind speed to operate wind turbine at the height of 10meters as shown below (http://tools.decc.gov.uk/en/windspeed/default.aspx). Hence this option has been discounted.

Wind speed at 45m agl (in m/s)

6.4	6.5	6.9
6.5	6.5	7.1
6.7	6.7	7.1

Wind speed at 25m agl (in m/s)

5.8	5.8	6.3
5.9	5.9	6.6
6.2	6.2	6.6

Wind speed at 10m agl (in m/s)

4.9	4.9	5.5
5	5	5.9
5.3	5.3	5.8

Blank squares indicate areas outside the land area of the UK - i.e. areas at sea or of neighbouring countries.
agl = above ground level.
Squares surrounding the central square correspond to wind speeds for surrounding grid squares.

Figure 8 Wind speed analysis for the development area

- **Air Source Heat Pumps (ASHP)**

ASHP can meet the space heating demands on site efficiently in comparison with gas boilers. Although this low carbon technology consumes electricity to operate, due to higher efficiency the heat output is much greater. However, the use of air source heat pumps would not be feasible for the residential units based on the following reasons:

i. ASHP evaporators would need to be located externally, any noise associated with the units could potentially be an issue.
ii. Issues of noise may be of concern at night, as the development is largely residential.

Hence, this option has not been considered as a feasible option for the residential units.

9.2. Proposed Technology

- **Photovoltaic (PV)**

Based on the feasibility study above, PV would be the most suitable renewable Technology for the following reasons:

i. The installation of PV is much simpler when compared to other renewable technologies
ii. There is sufficient roof space available to install enough PV modules to have a significant impact on carbon emissions of the development
iii. PV panels sited on the roof within an urban area are less visually intrusive when compared to wind turbines

The PV system capacity for the whole development depends upon the heating system selected. Therefore, the amount of PV relating to the proposed heating system option is outlined below:

Individual Combi Boilers for residential

+

6.75 kWp PV

The tables below illustrate the indicative PV panel's detail, should it be feasible to implement:

Orientation	South East/ South West	**Number of Panels**	Approximate 27
Panel Tilt	30°	**Power Output**	250 W/p
Overshading	Less than 20 percent	**Type**	Monocrystalline
Proportion Exported	50%	**PV Area**	Approximate 45 m^2 (27 panels * 1.65 m^2)
Annual Ouput	Approximate 5,133 kWh		

Table 12 Suggested PV details

For the 6.75 kWp system, 27 monocrystalline PV panels with 250 w/p power output, would to be installed at 30°. The area on the roof could be utilised for the PV panels and condenser units. For flat roofs as a rule of thumb, 400mm between rows of panels has been considered. The proposed PV panels are subject to further consideration at detailed design stage. In order to qualify both the installer and the equipment, the system must be certified under the Microgeneration Certification Scheme (MCS).

The Feed - In – Tariffs (FIT) were introduced in order to give an incentive for PV generated electricity. The FIT scheme is based on the principle that the energy supplier pays generation tariff for every kWh the PV system generates and an export tariff for every kWh of electricity supplied back to the national grid. The table below shows FIT payment rate from 1 April 2016 – 31 March 2019 (https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-fit-generation-export-payment-rate-table-01-april-30-june-2016).

		2016/17				2017/18				2018/19			
		1 Apr– 30 Jun	1 Jul– 30 Sep	1 Oct– 31 Dec	1 Jan– 31Mar	1 Apr– 30 Jun	1 Jul– 30 Sep	1 Oct– 31 Dec	1 Jan– 31Mar	1 Apr– 30 Jun	1 Jul– 30 Sep	1 Oct– 31 Dec	1 Jan– 31Mar
Solar photovoltaic (≤10kW)	Higher	4.32	4.25	4.18	4.11	4.04	3.97	3.90	3.83	3.76	3.69	3.62	3.55
	Middle	3.89	3.83	3.76	3.70	3.64	3.57	3.51	3.45	3.38	3.32	3.26	3.20
	Lower	0.74	0.68	0.63	0.58	0.52	0.47	0.41	0.37	0.32	0.26	0.21	0.15
Solar photovoltaic (>10kW & ≤50kW)	Higher	4.53	4.46	4.39	4.32	4.25	4.19	4.12	4.05	3.98	3.91	3.85	3.78
	Middle	4.08	4.01	3.95	3.89	3.83	3.77	3.71	3.65	3.58	3.52	3.47	3.40
	Lower	0.74	0.68	0.63	0.58	0.52	0.47	0.41	0.37	0.32	0.26	0.21	0.15
Solar photovoltaic (>50kW & ≤250kW)	Higher	2.38	2.32	2.26	2.21	2.15	2.10	2.04	1.98	1.93	1.87	1.82	1.76
	Middle	2.14	2.09	2.03	1.99	1.94	1.89	1.84	1.78	1.74	1.68	1.64	1.58
	Lower	0.74	0.68	0.63	0.58	0.52	0.47	0.41	0.37	0.32	0.26	0.21	0.15

Table 13 FIT Generation & Export Payment Rate Table (pence/kWh)

Given the proposed LZC technologies on the site (**PVs**), the overall CO_2 reduction at BE GREEN stage can be calculated as shown below. And, it can be seen that the overall CO_2 reduction via on-site renewables is ***25.1%*** for the total emissions.

BE GREEN stage

		BE CLEAN	BE GREEN
		CO_2 **Emissions** (Tonnes CO_2/yr)	CO_2 **Emissions** (Tonnes CO_2/yr)
Residential	Flat 1	1.59	1.26
	Flat 2	0.99	0.65
	Flat 3	1.17	0.83
	Flat 4	1.49	1.15
	Flat 5	1.56	1.22
	Flat 6	1.51	1.17
	Flat 7	1.38	1.05
	Flat 8	1.32	0.99
	Flat 9	1.04	0.71
TOTAL		**12.06**	**9.03**
Carbon Reduction		**-**	**25.1%**

Table 14 Regulated Energy Use and Carbon Reduction at Be Green Stage

10. Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **35 York Way, London N7 9QF,** based on the information provided by the design team.

In line with the London Plan's three step energy hierarchy the regulated CO_2 emissions for this development have been reduced by **35.4%** over Building Regulation 2013, once all measures in the table below are taken into account.

Stages	Strategies
BE LEAN Energy efficient design	• U-values better than Building Regulations Part L. • Accredited Construction Details for all junctions • High efficient individual combi gas boilers for heating and hot water demand in residential units • Natural ventilation with extract fans in wet rooms • Low energy lights
BE CLEAN District heat networks or communal heating systems	Communal heating was not seen as a feasible heating option for this development due to unavailability of plant space and the site is not within reasonable proximity to existing or potential district heat networks.
BE GREEN On-site renewable technologies	• PV panels of 6.75kWp on the roof (approximate 27 panels with 250 w/p were used to demonstrate how this can be achieved).

Table 1615 Energy Hierarchy and suggested strategies

The carbon savings from each stage can be calculated as shown below. The total cumulative savings satisfy the requirement of the local policy requirements (35% reduction), and therefore there is no requirement to make a payment to the Carbon Offset Fund based on the shortfall below:

Energy Hierarchy		Regulated Carbon Savings	
		Tonnes CO_2/yr	%
BE LEAN	After energy demand reduction	1.93	13.8 %
BE CLEAN	After heat network/ CHP	-	-
BE GREEN	After renewable energy	3.03	25.1 %
Total Cumulative Savings		**4.96**	**35.4 %**
Total Target Savings		4.90	35.0 %
Shortfall		-0.06	-0.4 %
Carbon Offset Fund		**£0** (-0.06 tonnes CO_2* £60 * 30 years)	

Table 16 Carbon dioxide Emissions after each stage of the Energy Hierarchy

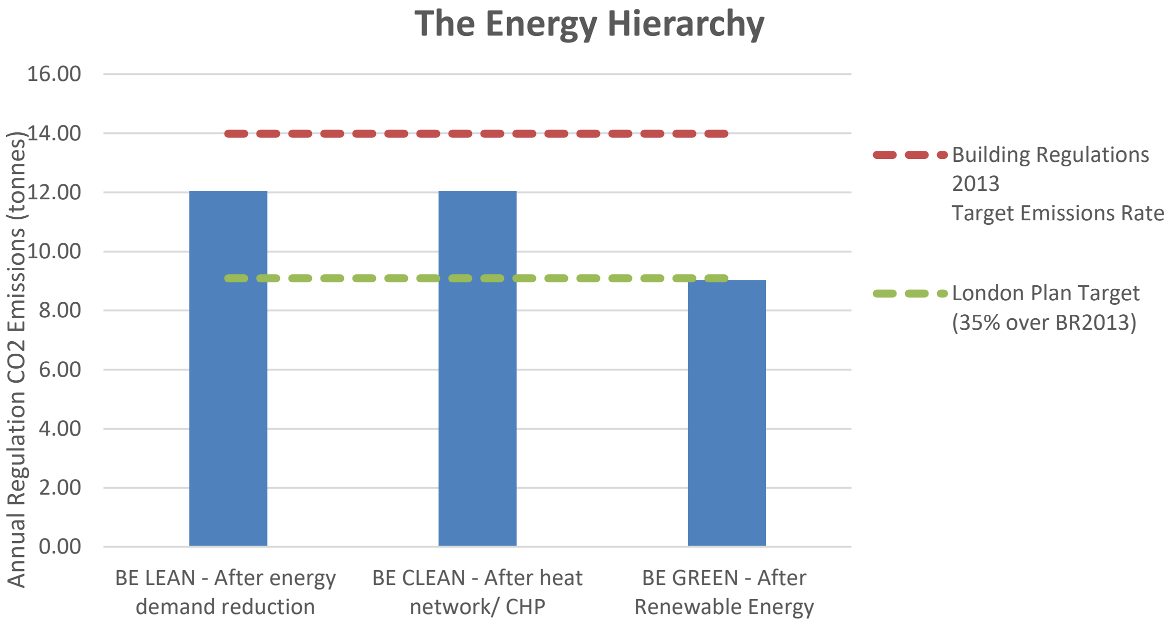


Figure 9 The Energy Hierarchy

11. Appendix

- ✓ SAP Block Compliance and SBEM reports

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 1

Address : Flat 1 , 35 York Way, Camden, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	93.1	(1a)	x	2.7	(2a)	=	251.37	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	93.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	251.37	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.12	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.32	(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) =	0.27	(21)

Infiltration rate modified for monthly wind speed

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

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

0.35	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.31	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.56	0.56	0.56	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			3.52	x1/[1/(1.1)+ 0.04]		=	3.71			(27)
Windows Type 2			2.24	x1/[1/(1.1)+ 0.04]		=	2.36			(27)
Windows Type 3			2.24	x1/[1/(1.1)+ 0.04]		=	2.36			(27)
Windows Type 4			1.83	x1/[1/(1.1)+ 0.04]		=	1.93			(27)
Windows Type 5			2.24	x1/[1/(1.1)+ 0.04]		=	2.36			(27)
Windows Type 6			1.83	x1/[1/(1.1)+ 0.04]		=	1.93			(27)
Floor			93.1	x	0.09	=	8.379001			(28)
Walls Type1	19.66	2.24	17.42	x	0.13	=	2.26			(29)
Walls Type2	33.02	3.52	29.5	x	0.13	=	3.84			(29)
Walls Type3	27.81	8.14	19.67	x	0.13	=	2.56			(29)
Walls Type4	14.53	2.3	12.23	x	0.12	=	1.44			(29)
Roof	10	0	10	x	0.1	=	1			(30)
Total area of elements, m²			198.11							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 37.34 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16926.47 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 13.84 | (36)

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

Total fabric heat loss (33) + (36) = | 51.18 | (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=	46.44	46.25	46.06	45.17	45.01	44.23	44.23	44.09	44.53	45.01	45.34	45.7	(38)

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

(39)m=	97.62	97.43	97.24	96.35	96.18	95.41	95.41	95.27	95.71	96.18	96.52	96.87	

Average = Sum(39)$_{1…12}$ /12= | 96.35 | (39)

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

(40)m=	1.05	1.05	1.04	1.03	1.03	1.02	1.02	1.02	1.03	1.03	1.04	1.04	

Average = Sum(40)$_{1…12}$ /12= | 1.03 | (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 | 2.67 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 97.51 | (43)

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

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

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

(44)m=	107.26	103.36	99.46	95.56	91.66	87.76	87.76	91.66	95.56	99.46	103.36	107.26	

Total = Sum(44)$_{1…12}$ = | 1170.16 | (44)

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

(45)m=	159.07	139.12	143.56	125.16	120.1	103.63	96.03	110.2	111.51	129.96	141.86	154.05	

Total = Sum(45)$_{1…12}$ = | 1534.26 | (45)

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

(46)m=	23.86	20.87	21.53	18.77	18.01	15.55	14.4	16.53	16.73	19.49	21.28	23.11	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.69	47.13	46.71	43.28	44.72	46.71	47.13	50.69	49.32	50.96	(61)

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

(62)m=	210.03	185.15	194.25	172.29	166.81	146.91	140.75	156.91	158.64	180.64	191.18	205.01	(62)

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

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

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

Output from water heater

(64)m=	210.03	185.15	194.25	172.29	166.81	146.91	140.75	156.91	158.64	180.64	191.18	205.01

Output from water heater (annual)$_{1...12}$ 2108.57 (64)

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

(65)m=	65.63	57.77	60.41	53.4	51.61	45.28	43.11	48.32	48.86	55.88	59.5	63.96	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	159.95	159.95	159.95	159.95	159.95	159.95	159.95	159.95	159.95	159.95	159.95	159.95	(66)

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

(67)m=	56.75	50.4	40.99	31.03	23.2	19.58	21.16	27.5	36.92	46.87	54.71	58.32	(67)

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

(68)m=	365.17	368.96	359.41	339.09	313.42	289.31	273.19	269.4	278.95	299.28	324.94	349.06	(68)

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

(69)m=	53.66	53.66	53.66	53.66	53.66	53.66	53.66	53.66	53.66	53.66	53.66	53.66	(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=	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	-106.63	(71)

Water heating gains (Table 5)

(72)m=	88.21	85.96	81.19	74.16	69.37	62.89	57.95	64.94	67.86	75.11	82.64	85.97	(72)

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

(73)m=	620.11	615.3	591.57	554.26	515.96	481.75	462.28	471.83	493.71	531.25	572.27	603.33	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	2.24	x	11.28	x	0.7	x	0.76	=	9.32	(75)
Northeast	0.9x	0.77	x	1.83	x	11.28	x	0.7	x	0.76	=	7.61	(75)
Northeast	0.9x	0.77	x	2.24	x	11.28	x	0.7	x	0.76	=	9.32	(75)
Northeast	0.9x	0.77	x	1.83	x	11.28	x	0.7	x	0.76	=	7.61	(75)
Northeast	0.9x	0.77	x	2.24	x	22.97	x	0.7	x	0.76	=	18.97	(75)
Northeast	0.9x	0.77	x	1.83	x	22.97	x	0.7	x	0.76	=	15.5	(75)
Northeast	0.9x	0.77	x	2.24	x	22.97	x	0.7	x	0.76	=	18.97	(75)
Northeast	0.9x	0.77	x	1.83	x	22.97	x	0.7	x	0.76	=	15.5	(75)
Northeast	0.9x	0.77	x	2.24	x	41.38	x	0.7	x	0.76	=	34.17	(75)
Northeast	0.9x	0.77	x	1.83	x	41.38	x	0.7	x	0.76	=	27.92	(75)
Northeast	0.9x	0.77	x	2.24	x	41.38	x	0.7	x	0.76	=	34.17	(75)
Northeast	0.9x	0.77	x	1.83	x	41.38	x	0.7	x	0.76	=	27.92	(75)
Northeast	0.9x	0.77	x	2.24	x	67.96	x	0.7	x	0.76	=	56.12	(75)
Northeast	0.9x	0.77	x	1.83	x	67.96	x	0.7	x	0.76	=	45.85	(75)
Northeast	0.9x	0.77	x	2.24	x	67.96	x	0.7	x	0.76	=	56.12	(75)
Northeast	0.9x	0.77	x	1.83	x	67.96	x	0.7	x	0.76	=	45.85	(75)
Northeast	0.9x	0.77	x	2.24	x	91.35	x	0.7	x	0.76	=	75.44	(75)
Northeast	0.9x	0.77	x	1.83	x	91.35	x	0.7	x	0.76	=	61.63	(75)
Northeast	0.9x	0.77	x	2.24	x	91.35	x	0.7	x	0.76	=	75.44	(75)
Northeast	0.9x	0.77	x	1.83	x	91.35	x	0.7	x	0.76	=	61.63	(75)
Northeast	0.9x	0.77	x	2.24	x	97.38	x	0.7	x	0.76	=	80.42	(75)
Northeast	0.9x	0.77	x	1.83	x	97.38	x	0.7	x	0.76	=	65.7	(75)
Northeast	0.9x	0.77	x	2.24	x	97.38	x	0.7	x	0.76	=	80.42	(75)
Northeast	0.9x	0.77	x	1.83	x	97.38	x	0.7	x	0.76	=	65.7	(75)
Northeast	0.9x	0.77	x	2.24	x	91.1	x	0.7	x	0.76	=	75.23	(75)
Northeast	0.9x	0.77	x	1.83	x	91.1	x	0.7	x	0.76	=	61.46	(75)
Northeast	0.9x	0.77	x	2.24	x	91.1	x	0.7	x	0.76	=	75.23	(75)
Northeast	0.9x	0.77	x	1.83	x	91.1	x	0.7	x	0.76	=	61.46	(75)
Northeast	0.9x	0.77	x	2.24	x	72.63	x	0.7	x	0.76	=	59.98	(75)
Northeast	0.9x	0.77	x	1.83	x	72.63	x	0.7	x	0.76	=	49	(75)
Northeast	0.9x	0.77	x	2.24	x	72.63	x	0.7	x	0.76	=	59.98	(75)
Northeast	0.9x	0.77	x	1.83	x	72.63	x	0.7	x	0.76	=	49	(75)
Northeast	0.9x	0.77	x	2.24	x	50.42	x	0.7	x	0.76	=	41.64	(75)
Northeast	0.9x	0.77	x	1.83	x	50.42	x	0.7	x	0.76	=	34.02	(75)
Northeast	0.9x	0.77	x	2.24	x	50.42	x	0.7	x	0.76	=	41.64	(75)
Northeast	0.9x	0.77	x	1.83	x	50.42	x	0.7	x	0.76	=	34.02	(75)
Northeast	0.9x	0.77	x	2.24	x	28.07	x	0.7	x	0.76	=	23.18	(75)
Northeast	0.9x	0.77	x	1.83	x	28.07	x	0.7	x	0.76	=	18.94	(75)
Northeast	0.9x	0.77	x	2.24	x	28.07	x	0.7	x	0.76	=	23.18	(75)

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Northeast 0.9x	0.77	x	1.83	x	28.07	x	0.7	x	0.76	=	18.94	(75)
Northeast 0.9x	0.77	x	2.24	x	14.2	x	0.7	x	0.76	=	11.72	(75)
Northeast 0.9x	0.77	x	1.83	x	14.2	x	0.7	x	0.76	=	9.58	(75)
Northeast 0.9x	0.77	x	2.24	x	14.2	x	0.7	x	0.76	=	11.72	(75)
Northeast 0.9x	0.77	x	1.83	x	14.2	x	0.7	x	0.76	=	9.58	(75)
Northeast 0.9x	0.77	x	2.24	x	9.21	x	0.7	x	0.76	=	7.61	(75)
Northeast 0.9x	0.77	x	1.83	x	9.21	x	0.7	x	0.76	=	6.22	(75)
Northeast 0.9x	0.77	x	2.24	x	9.21	x	0.7	x	0.76	=	7.61	(75)
Northeast 0.9x	0.77	x	1.83	x	9.21	x	0.7	x	0.76	=	6.22	(75)
Southwest0.9x	0.77	x	2.24	x	36.79		0.7	x	0.76	=	30.39	(79)
Southwest0.9x	0.77	x	2.24	x	62.67		0.7	x	0.76	=	51.76	(79)
Southwest0.9x	0.77	x	2.24	x	85.75		0.7	x	0.76	=	70.82	(79)
Southwest0.9x	0.77	x	2.24	x	106.25		0.7	x	0.76	=	87.75	(79)
Southwest0.9x	0.77	x	2.24	x	119.01		0.7	x	0.76	=	98.28	(79)
Southwest0.9x	0.77	x	2.24	x	118.15		0.7	x	0.76	=	97.57	(79)
Southwest0.9x	0.77	x	2.24	x	113.91		0.7	x	0.76	=	94.07	(79)
Southwest0.9x	0.77	x	2.24	x	104.39		0.7	x	0.76	=	86.21	(79)
Southwest0.9x	0.77	x	2.24	x	92.85		0.7	x	0.76	=	76.68	(79)
Southwest0.9x	0.77	x	2.24	x	69.27		0.7	x	0.76	=	57.2	(79)
Southwest0.9x	0.77	x	2.24	x	44.07		0.7	x	0.76	=	36.39	(79)
Southwest0.9x	0.77	x	2.24	x	31.49		0.7	x	0.76	=	26	(79)
Northwest 0.9x	0.77	x	3.52	x	11.28	x	0.7	x	0.76	=	14.64	(81)
Northwest 0.9x	0.77	x	3.52	x	22.97	x	0.7	x	0.76	=	29.8	(81)
Northwest 0.9x	0.77	x	3.52	x	41.38	x	0.7	x	0.76	=	53.7	(81)
Northwest 0.9x	0.77	x	3.52	x	67.96	x	0.7	x	0.76	=	88.19	(81)
Northwest 0.9x	0.77	x	3.52	x	91.35	x	0.7	x	0.76	=	118.54	(81)
Northwest 0.9x	0.77	x	3.52	x	97.38	x	0.7	x	0.76	=	126.38	(81)
Northwest 0.9x	0.77	x	3.52	x	91.1	x	0.7	x	0.76	=	118.23	(81)
Northwest 0.9x	0.77	x	3.52	x	72.63	x	0.7	x	0.76	=	94.25	(81)
Northwest 0.9x	0.77	x	3.52	x	50.42	x	0.7	x	0.76	=	65.43	(81)
Northwest 0.9x	0.77	x	3.52	x	28.07	x	0.7	x	0.76	=	36.42	(81)
Northwest 0.9x	0.77	x	3.52	x	14.2	x	0.7	x	0.76	=	18.42	(81)
Northwest 0.9x	0.77	x	3.52	x	9.21	x	0.7	x	0.76	=	11.96	(81)

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

(83)m=	78.89	150.49	248.69	379.87	490.96	516.2	485.69	398.41	293.43	177.86	97.42	65.61	(83)

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

(84)m=	699	765.79	840.27	934.13	1006.92	997.96	947.97	870.25	787.14	709.1	669.69	668.95	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	0.99	0.99	0.97	0.92	0.79	0.6	0.44	0.5	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=	20.04	20.17	20.39	20.69	20.9	20.98	21	20.99	20.94	20.66	20.3	20.01	(87)

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

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

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

(89)m=	0.99	0.99	0.97	0.9	0.74	0.52	0.35	0.4	0.69	0.93	0.98	0.99	(89)

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

(90)m=	18.77	18.96	19.29	19.7	19.96	20.05	20.06	20.06	20.01	19.68	19.16	18.74	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	19.2	19.36	19.65	20.03	20.28	20.36	20.37	20.37	20.32	20.01	19.54	19.16	(92)

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

(93)m=	19.05	19.21	19.5	19.88	20.13	20.21	20.22	20.22	20.17	19.86	19.39	19.01	(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=	0.99	0.98	0.96	0.89	0.74	0.53	0.36	0.42	0.7	0.92	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	691.73	752.12	807.28	834.08	746.67	527.33	344.87	362.46	547.89	655.35	656.55	663.32	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1439.43	1394.37	1264.53	1057.71	810.36	535.47	345.71	364.19	581.15	890.32	1186.3	1434.81	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	556.29	431.59	340.19	161.02	47.39	0	0	0	0	174.82	381.42	573.98	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2666.7 (98)

Space heating requirement in kWh/m²/year 28.64 (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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	556.29	431.59	340.19	161.02	47.39	0	0	0	0	174.82	381.42	573.98	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	612.65	475.32	374.66	177.33	52.19	0	0	0	0	192.53	420.07	632.14	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2936.9 (211)

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

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

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

Water heating

Output from water heater (calculated above)

210.03	185.15	194.25	172.29	166.81	146.91	140.75	156.91	158.64	180.64	191.18	205.01

Efficiency of water heater 81.5 (216)

(217)m=	88.05	87.79	87.18	85.74	83.39	81.5	81.5	81.5	81.5	85.82	87.47	88.15

(217)

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

(219)m=	238.54	210.9	222.8	200.94	200.03	180.26	172.7	192.53	194.65	210.48	218.57	232.56

Total = Sum(219a)$_{1...12}$ = 2474.97 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2936.9	
Water heating fuel used		2474.97	
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		400.86	(232)
Electricity generated by PVs		-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	102.2	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	86.13	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)		13.19	x 0.01 =	52.87	(250)
Additional standing charges (Table 12)					120	(251)
	one of (233) to (235) x)		13.19	x 0.01 =	0	(252)

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

Total energy cost (245)...(247) + (250)…(254) = 371.1 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.13	(257)

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SAP rating (Section 12)				84.26	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	634.37	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	534.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1168.96	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	208.05	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		1079.77	(272)
CO2 emissions per m²		(272) ÷ (4) =		11.6	(273)
EI rating (section 14)				90	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3583.01	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3019.46	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6602.48	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1230.64	(268)
Energy saving/generation technologies Item 1		3.07	=	-1988.48	(269)
'Total Primary Energy		sum of (265)…(271) =		6074.88	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		65.25	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.11	(1a)	x	2.7	(2a)	=	135.3	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.11	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	135.3	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.15	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.35	(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) =	0.3	(21)

Infiltration rate modified for monthly wind speed

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

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

0.38	0.37	0.36	0.33	0.32	0.28	0.28	0.27	0.3	0.32	0.33	0.35

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			1.78	x1/[1/(1.1)+ 0.04]		=	1.88			(27)
Windows Type 2			2.24	x1/[1/(1.1)+ 0.04]		=	2.36			(27)
Windows Type 3			0.77	x1/[1/(1.1)+ 0.04]		=	0.81			(27)
Windows Type 4			0.77	x1/[1/(1.1)+ 0.04]		=	0.81			(27)
Floor			50.11	x	0.09	=	4.5099			(28)
Walls Type1	16.33	4.02	12.31	x	0.13	=	1.6			(29)
Walls Type2	22.41	1.54	20.87	x	0.13	=	2.71			(29)
Walls Type3	13.5	2.3	11.2	x	0.12	=	1.32			(29)
Total area of elements, m²			102.35							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.22 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 9435.35 (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 9.49 (36)

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

Total fabric heat loss (33) + (36) = 28.71 (37)

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

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.5	25.37	25.25	24.69	24.58	24.09	24.09	23.99	24.28	24.58	24.79	25.02	(38)

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

(39)m=	54.2	54.08	53.96	53.39	53.28	52.79	52.79	52.7	52.98	53.28	53.5	53.72	

Average = Sum(39)$_{1...12}$ /12= 53.39 (39)

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

(40)m=	1.08	1.08	1.08	1.07	1.06	1.05	1.05	1.05	1.06	1.06	1.07	1.07	

Average = Sum(40)$_{1...12}$ /12= 1.07 (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 1.69 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.42 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	81.86	78.88	75.91	72.93	69.95	66.98	66.98	69.95	72.93	75.91	78.88	81.86

Total = Sum(44)$_{1...12}$ = 893 (44)

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

(45)m=	121.39	106.17	109.56	95.52	91.65	79.09	73.29	84.1	85.1	99.18	108.26	117.56

Total = Sum(45)$_{1...12}$ = 1170.87 (45)

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

(46)m=	18.21	15.93	16.43	14.33	13.75	11.86	10.99	12.61	12.77	14.88	16.24	17.63	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	41.71	36.31	38.68	35.96	35.65	33.03	34.13	35.65	35.96	38.68	38.9	41.71	(61)

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

(62)m=	163.11	142.48	148.24	131.48	127.3	112.12	107.42	119.74	121.07	137.86	147.16	159.28	(62)

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

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

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

Output from water heater

(64)m=	163.11	142.48	148.24	131.48	127.3	112.12	107.42	119.74	121.07	137.86	147.16	159.28

Output from water heater (annual)$_{1...12}$ | 1617.24 | (64)

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

(65)m=	50.79	44.38	46.1	40.75	39.39	34.55	32.9	36.87	37.29	42.65	45.72	49.52	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	101.6	(66)

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

(67)m=	36.46	32.39	26.34	19.94	14.91	12.58	13.6	17.67	23.72	30.12	35.15	37.48	(67)

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

(68)m=	220.18	222.46	216.71	204.45	188.98	174.43	164.72	162.43	168.19	180.45	195.92	210.46	(68)

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

(69)m=	46.85	46.85	46.85	46.85	46.85	46.85	46.85	46.85	46.85	46.85	46.85	46.85	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	-67.73	(71)

Water heating gains (Table 5)

(72)m=	68.27	66.04	61.96	56.6	52.94	47.99	44.22	49.56	51.79	57.32	63.5	66.56	(72)

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

(73)m=	408.63	404.61	388.72	364.71	340.54	318.73	306.26	313.39	327.42	351.61	378.3	398.22	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x	1	x	1.78	x	19.64	x	0.7	x	0.76	=	12.89	(76)
East	0.9x	1	x	2.24	x	19.64	x	0.7	x	0.76	=	16.22	(76)

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East	0.9x	1	x	1.78	x	38.42	x	0.7	x	0.76	=	25.21	(76)
East	0.9x	1	x	2.24	x	38.42	x	0.7	x	0.76	=	31.73	(76)
East	0.9x	1	x	1.78	x	63.27	x	0.7	x	0.76	=	41.52	(76)
East	0.9x	1	x	2.24	x	63.27	x	0.7	x	0.76	=	52.25	(76)
East	0.9x	1	x	1.78	x	92.28	x	0.7	x	0.76	=	60.56	(76)
East	0.9x	1	x	2.24	x	92.28	x	0.7	x	0.76	=	76.21	(76)
East	0.9x	1	x	1.78	x	113.09	x	0.7	x	0.76	=	74.22	(76)
East	0.9x	1	x	2.24	x	113.09	x	0.7	x	0.76	=	93.4	(76)
East	0.9x	1	x	1.78	x	115.77	x	0.7	x	0.76	=	75.97	(76)
East	0.9x	1	x	2.24	x	115.77	x	0.7	x	0.76	=	95.61	(76)
East	0.9x	1	x	1.78	x	110.22	x	0.7	x	0.76	=	72.33	(76)
East	0.9x	1	x	2.24	x	110.22	x	0.7	x	0.76	=	91.02	(76)
East	0.9x	1	x	1.78	x	94.68	x	0.7	x	0.76	=	62.13	(76)
East	0.9x	1	x	2.24	x	94.68	x	0.7	x	0.76	=	78.19	(76)
East	0.9x	1	x	1.78	x	73.59	x	0.7	x	0.76	=	48.29	(76)
East	0.9x	1	x	2.24	x	73.59	x	0.7	x	0.76	=	60.77	(76)
East	0.9x	1	x	1.78	x	45.59	x	0.7	x	0.76	=	29.92	(76)
East	0.9x	1	x	2.24	x	45.59	x	0.7	x	0.76	=	37.65	(76)
East	0.9x	1	x	1.78	x	24.49	x	0.7	x	0.76	=	16.07	(76)
East	0.9x	1	x	2.24	x	24.49	x	0.7	x	0.76	=	20.22	(76)
East	0.9x	1	x	1.78	x	16.15	x	0.7	x	0.76	=	10.6	(76)
East	0.9x	1	x	2.24	x	16.15	x	0.7	x	0.76	=	13.34	(76)
South	0.9x	0.77	x	0.77	x	46.75	x	0.7	x	0.76	=	13.27	(78)
South	0.9x	0.77	x	0.77	x	46.75	x	0.7	x	0.76	=	13.27	(78)
South	0.9x	0.77	x	0.77	x	76.57	x	0.7	x	0.76	=	21.74	(78)
South	0.9x	0.77	x	0.77	x	76.57	x	0.7	x	0.76	=	21.74	(78)
South	0.9x	0.77	x	0.77	x	97.53	x	0.7	x	0.76	=	27.69	(78)
South	0.9x	0.77	x	0.77	x	97.53	x	0.7	x	0.76	=	27.69	(78)
South	0.9x	0.77	x	0.77	x	110.23	x	0.7	x	0.76	=	31.29	(78)
South	0.9x	0.77	x	0.77	x	110.23	x	0.7	x	0.76	=	31.29	(78)
South	0.9x	0.77	x	0.77	x	114.87	x	0.7	x	0.76	=	32.61	(78)
South	0.9x	0.77	x	0.77	x	114.87	x	0.7	x	0.76	=	32.61	(78)
South	0.9x	0.77	x	0.77	x	110.55	x	0.7	x	0.76	=	31.38	(78)
South	0.9x	0.77	x	0.77	x	110.55	x	0.7	x	0.76	=	31.38	(78)
South	0.9x	0.77	x	0.77	x	108.01	x	0.7	x	0.76	=	30.66	(78)
South	0.9x	0.77	x	0.77	x	108.01	x	0.7	x	0.76	=	30.66	(78)
South	0.9x	0.77	x	0.77	x	104.89	x	0.7	x	0.76	=	29.78	(78)
South	0.9x	0.77	x	0.77	x	104.89	x	0.7	x	0.76	=	29.78	(78)
South	0.9x	0.77	x	0.77	x	101.89	x	0.7	x	0.76	=	28.92	(78)
South	0.9x	0.77	x	0.77	x	101.89	x	0.7	x	0.76	=	28.92	(78)
South	0.9x	0.77	x	0.77	x	82.59	x	0.7	x	0.76	=	23.44	(78)

South	0.9x	0.77	x	0.77	x	82.59	x	0.7	x	0.76	=	23.44	(78)
South	0.9x	0.77	x	0.77	x	55.42	x	0.7	x	0.76	=	15.73	(78)
South	0.9x	0.77	x	0.77	x	55.42	x	0.7	x	0.76	=	15.73	(78)
South	0.9x	0.77	x	0.77	x	40.4	x	0.7	x	0.76	=	11.47	(78)
South	0.9x	0.77	x	0.77	x	40.4	x	0.7	x	0.76	=	11.47	(78)

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

(83)m=	55.65	100.41	149.15	199.35	232.83	234.35	224.68	199.87	166.91	114.46	67.76	46.87	(83)

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

(84)m=	464.28	505.02	537.88	564.06	573.37	553.08	530.93	513.26	494.33	466.07	446.06	445.09	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.89	0.78	0.59	0.43	0.47	0.7	0.91	0.97	0.99	(86)

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

(87)m=	20.15	20.28	20.49	20.73	20.9	20.98	21	21	20.96	20.75	20.41	20.12	(87)

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

(88)m=	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.02	(88)

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

(89)m=	0.98	0.97	0.94	0.86	0.72	0.51	0.34	0.37	0.61	0.87	0.96	0.98	(89)

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

(90)m=	18.91	19.1	19.4	19.73	19.94	20.03	20.04	20.04	20.01	19.76	19.3	18.88	(90)

fLA = Living area ÷ (4) = 0.44 (91)

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

(92)m=	19.45	19.62	19.87	20.17	20.36	20.44	20.46	20.46	20.42	20.19	19.78	19.42	(92)

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

(93)m=	19.3	19.47	19.72	20.02	20.21	20.29	20.31	20.31	20.27	20.04	19.63	19.27	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.93	0.86	0.73	0.53	0.37	0.4	0.64	0.87	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	453.64	486.66	502.24	486.81	418.68	295.4	195.14	205.01	314.09	406.9	427.71	436.58	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	813.27	787.89	713.45	593.55	453.57	300.62	195.7	205.9	327.01	503.22	670.57	809.62	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	267.56	202.43	157.14	76.85	25.96	0	0	0	0	71.66	174.85	277.55	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 1254.01 (98)

Space heating requirement in kWh/m²/year 25.03 (99)

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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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	267.56	202.43	157.14	76.85	25.96	0	0	0	0	71.66	174.85	277.55		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	294.67	222.94	173.06	84.64	28.59	0	0	0	0	78.92	192.57	305.67		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1381.06	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	163.11	142.48	148.24	131.48	127.3	112.12	107.42	119.74	121.07	137.86	147.16	159.28		
Efficiency of water heater													81.5	(216)
(217)m=	87.04	86.71	86.03	84.7	82.94	81.5	81.5	81.5	81.5	84.46	86.3	87.17		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	187.4	164.31	172.3	155.23	153.48	137.57	131.8	146.92	148.55	163.23	170.52	182.71		
Total = Sum(219a)$_{1...12}$ =													1914.03	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1381.06	
Water heating fuel used			1914.03	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			257.58	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	48.06	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)

Water heating cost (other fuel)	(219)	3.48	x 0.01 =	66.61	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	33.97	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)

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

Total energy cost	(245)...(247) + (250)…(254) =	193.1	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.85	(257)
SAP rating (Section 12)		88.1	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	298.31	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	413.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =			711.74	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	133.68	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		548.18	(272)
CO2 emissions per m²		(272) ÷ (4) =		10.94	(273)
EI rating (section 14)				92	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1684.9	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2335.11	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4020.01	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	790.76	(268)
Energy saving/generation technologies Item 1		3.07	=	-1988.48	(269)

'Total Primary Energy	sum of (265)…(271) =	3052.54	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =	60.92	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	54.43	(1a) x	2.7	(2a) =	146.96	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.43	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	146.96	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.14	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.34	(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) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(24d)

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

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 2			7.05	x1/[1/(1.1)+ 0.04]		=	7.43			(27)
Windows Type 3			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 4			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Floor			54.43	x	0.09	=	4.8987			(28)
Walls Type1	11.61	3.58	8.03	x	0.13	=	1.04			(29)
Walls Type2	24.3	1.79	22.51	x	0.13	=	2.93			(29)
Walls Type3	27.67	7.05	20.62	x	0.13	=	2.68			(29)
Walls Type4	27.41	2.3	25.11	x	0.12	=	2.95			(29)
Total area of elements, m²			145.42							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 30.81 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15579.9 (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 18.21 (36)

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

Total fabric heat loss (33) + (36) = 49.02 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.47	27.34	27.22	26.64	26.54	26.03	26.03	25.94	26.23	26.54	26.75	26.98	(38)

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

(39)m=	76.48	76.36	76.24	75.66	75.55	75.05	75.05	74.96	75.24	75.55	75.77	76	

Average = Sum(39)$_{1…12}$ /12= 75.66 (39)

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

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

Average = Sum(40)$_{1…12}$ /12= 1.39 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.82 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 77.44 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	85.18	82.09	78.99	75.89	72.79	69.7	69.7	72.79	75.89	78.99	82.09	85.18

Total = Sum(44)$_{1…12}$ = 929.28 (44)

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

(45)m=	126.33	110.49	114.01	99.4	95.37	82.3	76.26	87.51	88.56	103.21	112.66	122.34

Total = Sum(45)$_{1…12}$ = 1218.44 (45)

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

(46)m=	18.95	16.57	17.1	14.91	14.31	12.35	11.44	13.13	13.28	15.48	16.9	18.35	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

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

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

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

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

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

(61)m=	43.41	37.78	40.25	37.43	37.09	34.37	35.52	37.09	37.43	40.25	40.48	43.41	(61)

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

(62)m=	169.73	148.27	154.26	136.82	132.47	116.67	111.78	124.61	125.98	143.46	153.14	165.75	(62)

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

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

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

Output from water heater

(64)m=	169.73	148.27	154.26	136.82	132.47	116.67	111.78	124.61	125.98	143.46	153.14	165.75

Output from water heater (annual)$_{1...12}$ — 1682.95 (64)

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

(65)m=	52.86	46.18	47.97	42.41	40.99	35.96	34.24	38.37	38.8	44.38	47.58	51.53	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	109.24	109.24	109.24	109.24	109.24	109.24	109.24	109.24	109.24	109.24	109.24	109.24	(66)

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

(67)m=	35.37	31.42	25.55	19.34	14.46	12.21	13.19	17.15	23.01	29.22	34.1	36.36	(67)

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

(68)m=	236.89	239.35	233.15	219.97	203.32	187.67	177.22	174.76	180.96	194.14	210.79	226.44	(68)

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

(69)m=	47.74	47.74	47.74	47.74	47.74	47.74	47.74	47.74	47.74	47.74	47.74	47.74	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	-72.83	(71)

Water heating gains (Table 5)

(72)m=	71.04	68.72	64.48	58.9	55.09	49.94	46.02	51.58	53.89	59.65	66.08	69.26	(72)

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

(73)m=	430.46	426.65	410.34	385.36	360.02	336.98	323.59	330.64	345.02	370.17	398.14	419.21	(73)

6. Solar gains:

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

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

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North	0.9x	0.77	x	1.79	x	10.63	x	0.76	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.79	x	10.63	x	0.76	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.76	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.76	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.76	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.76	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.76	x	0.7	=	36.6	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.76	x	0.7	=	36.6	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.76	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.76	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.76	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.76	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.76	x	0.7	=	49.28	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.76	x	0.7	=	49.28	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.76	x	0.7	=	39.1	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.76	x	0.7	=	39.1	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.76	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.76	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.76	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.76	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.76	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.76	x	0.7	=	5.85	(74)
South	0.9x	0.77	x	7.05	x	46.75	x	0.76	x	0.7	=	121.52	(78)
South	0.9x	0.77	x	7.05	x	76.57	x	0.76	x	0.7	=	199.01	(78)
South	0.9x	0.77	x	7.05	x	97.53	x	0.76	x	0.7	=	253.51	(78)
South	0.9x	0.77	x	7.05	x	110.23	x	0.76	x	0.7	=	286.52	(78)
South	0.9x	0.77	x	7.05	x	114.87	x	0.76	x	0.7	=	298.57	(78)
South	0.9x	0.77	x	7.05	x	110.55	x	0.76	x	0.7	=	287.33	(78)
South	0.9x	0.77	x	7.05	x	108.01	x	0.76	x	0.7	=	280.74	(78)
South	0.9x	0.77	x	7.05	x	104.89	x	0.76	x	0.7	=	272.64	(78)
South	0.9x	0.77	x	7.05	x	101.89	x	0.76	x	0.7	=	264.82	(78)
South	0.9x	0.77	x	7.05	x	82.59	x	0.76	x	0.7	=	214.65	(78)
South	0.9x	0.77	x	7.05	x	55.42	x	0.76	x	0.7	=	144.04	(78)
South	0.9x	0.77	x	7.05	x	40.4	x	0.76	x	0.7	=	105	(78)
West	0.9x	0.77	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(80)
West	0.9x	0.77	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(80)
West	0.9x	0.77	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(80)
West	0.9x	0.77	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(80)
West	0.9x	0.77	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(80)

West	0.9x	0.77	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(80)
West	0.9x	0.77	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(80)
West	0.9x	0.77	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(80)
West	0.9x	0.77	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(80)
West	0.9x	0.77	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(80)
West	0.9x	0.77	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(80)

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

(83)m=	148.51	251.19	340.84	420.62	471.82	469.3	452.04	413.31	368.18	276.67	177.51	127.36	(83)

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

(84)m=	578.97	677.83	751.18	805.99	831.84	806.28	775.63	743.96	713.2	646.84	575.65	546.57	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.96	0.93	0.86	0.74	0.57	0.42	0.45	0.67	0.88	0.97	0.99	(86)

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

(87)m=	19.83	20.05	20.33	20.63	20.85	20.96	20.99	20.99	20.93	20.64	20.18	19.78	(87)

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

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

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

(89)m=	0.98	0.95	0.91	0.82	0.67	0.47	0.31	0.34	0.57	0.84	0.95	0.98	(89)

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

(90)m=	18.27	18.58	18.97	19.38	19.65	19.76	19.78	19.78	19.73	19.41	18.77	18.2	(90)

fLA = Living area ÷ (4) = 0.59 (91)

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

(92)m=	19.2	19.45	19.78	20.13	20.36	20.48	20.5	20.5	20.44	20.14	19.61	19.14	(92)

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

(93)m=	19.05	19.3	19.63	19.98	20.21	20.33	20.35	20.35	20.29	19.99	19.46	18.99	(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=	0.97	0.95	0.91	0.83	0.7	0.52	0.36	0.39	0.61	0.85	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	562.42	642.69	681.51	667.24	579.16	416.33	279.26	292.71	437.66	548.66	546.43	533.79	(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=	1127.94	1099.88	1000.87	837.96	643.27	429.72	281.43	295.93	465.93	709.72	936.43	1124.05	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	420.75	307.23	237.61	122.92	47.69	0	0	0	0	119.83	280.8	439.15	

	Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1975.99	(98)
Space heating requirement in kWh/m²/year		36.3	(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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	420.75	307.23	237.61	122.92	47.69	0	0	0	0	119.83	280.8	439.15		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	463.38	338.36	261.68	135.38	52.53	0	0	0	0	131.97	309.25	483.65		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2176.2	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)
Water heating														
Output from water heater (calculated above)														
	169.73	148.27	154.26	136.82	132.47	116.67	111.78	124.61	125.98	143.46	153.14	165.75		
Efficiency of water heater													81.5	(216)
(217)m=	87.92	87.55	86.9	85.65	83.77	81.5	81.5	81.5	81.5	85.48	87.29	88.05		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	193.06	169.36	177.52	159.74	158.13	143.16	137.15	152.89	154.58	167.82	175.45	188.25		
Total = Sum(219a)$_{1...12}$ =													1977.12	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2176.2	
Water heating fuel used			1977.12	
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			249.89	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

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

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Space heating - main system 1	(211) x	3.48	x 0.01 =	75.73	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	68.8	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	32.96	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)

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

Total energy cost	(245)...(247) + (250)…(254) =	221.95	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.94	(257)
SAP rating (Section 12)		86.92	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	470.06	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	427.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =			897.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	129.69	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		729.57	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.4	(273)
EI rating (section 14)				90	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2654.96	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2412.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5067.05	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x		3.07	=	230.25	(267)
Electricity for lighting	(232) x		0	=	767.15	(268)
Energy saving/generation technologies						
Item 1			3.07	=	-1988.48	(269)
'Total Primary Energy		sum of (265)…(271) =			4075.96	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			74.88	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 4

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	94.62	(1a) x	2.7	(2a) =	255.47	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.62	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	255.47	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.16	(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			4	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.36	(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) =	0.3	(21)

Infiltration rate modified for monthly wind speed

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

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

0.39	0.38	0.37	0.33	0.33	0.29	0.29	0.28	0.3	0.33	0.34	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.3	=	2.99			(26)
Windows Type 1			1.41	x1/[1/(1.1)+ 0.04]		=	1.49			(27)
Windows Type 2			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 3			1.41	x1/[1/(1.1)+ 0.04]		=	1.49			(27)
Windows Type 4			3.52	x1/[1/(1.1)+ 0.04]		=	3.71			(27)
Windows Type 5			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 6			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 7			2.19	x1/[1/(1.1)+ 0.04]		=	2.31			(27)
Windows Type 8			0.97	x1/[1/(1.1)+ 0.04]		=	1.02			(27)
Windows Type 9			0.97	x1/[1/(1.1)+ 0.04]		=	1.02			(27)
Floor			0.566	x	0.09	=	0.05094			(28)
Walls Type1	19.98	4.93	15.05	x	0.13	=	1.96			(29)
Walls Type2	42.88	4.17	38.71	x	0.13	=	5.03			(29)
Walls Type3	23.35	5.77	17.58	x	0.13	=	2.29			(29)
Walls Type4	42.66	2.3	40.36	x	0.12	=	4.74			(29)
Walls Type5	0.99	0.97	0.02	x	0.13	=	0			(29)
Roof Type1	6.5	0	6.5	x	0.1	=	0.65			(30)
Roof Type2	0.57	0	0.57	x	0.1	=	0.06			(30)
Total area of elements, m²			137.49							(31)

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** 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) =	34.46	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	21332.65	(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		10.62	(36)

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

Total fabric heat loss	(33) + (36) =	45.08	(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=	48.45	48.2	47.96	46.84	46.63	45.65	45.65	45.47	46.03	46.63	47.05	47.5	(38)

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

(39)m=	93.53	93.28	93.04	91.92	91.71	90.73	90.73	90.55	91.1	91.71	92.13	92.58	

Average = Sum(39)$_{1…12}$ /12= 91.92 (39)

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

(40)m=	0.99	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.97	0.97	0.98	

Average = Sum(40)$_{1…12}$ /12= 0.97 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.68 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 97.94 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	107.74	103.82	99.9	95.98	92.06	88.15	88.15	92.06	95.98	99.9	103.82	107.74

Total = Sum(44)$_{1…12}$ = 1175.29 (44)

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

(45)m=	159.77	139.73	144.19	125.71	120.62	104.09	96.45	110.68	112	130.53	142.48	154.73

Total = Sum(45)$_{1…12}$ = 1540.99 (45)

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

(46)m=	23.97	20.96	21.63	18.86	18.09	15.61	14.47	16.6	16.8	19.58	21.37	23.21	(46)

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.91	47.33	46.92	43.47	44.92	46.92	47.33	50.91	49.32	50.96	(61)

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

(62)m=	210.73	185.76	195.1	173.04	167.54	147.56	141.37	157.6	159.34	181.44	191.8	205.69	(62)

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

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

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

Output from water heater

(64)m=	210.73	185.76	195.1	173.04	167.54	147.56	141.37	157.6	159.34	181.44	191.8	205.69

Output from water heater (annual)$_{1...12}$ 2116.95 (64)

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

(65)m=	65.86	57.97	60.67	53.63	51.84	45.48	43.3	48.53	49.07	56.13	59.7	64.19	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	161.03	161.03	161.03	161.03	161.03	161.03	161.03	161.03	161.03	161.03	161.03	161.03	(66)

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

(67)m=	57.01	50.64	41.18	31.18	23.31	19.68	21.26	27.63	37.09	47.1	54.97	58.6	(67)

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

(68)m=	369.14	372.97	363.32	342.77	316.83	292.45	276.16	272.33	281.98	302.53	328.47	352.86	(68)

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

(69)m=	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	(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=	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	(71)

Water heating gains (Table 5)

(72)m=	88.52	86.26	81.55	74.49	69.67	63.16	58.2	65.23	68.16	75.44	82.92	86.27	(72)

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

(73)m=	625.14	620.34	596.51	558.9	520.27	485.75	466.08	475.66	497.7	535.53	576.83	608.19	(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)	
North	0.9x	0.77	x	1.79	x	10.63	x	0.76	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.41	x	10.63	x	0.76	x	0.7	=	5.53	(74)
North	0.9x	0.77	x	0.97	x	10.63	x	0.76	x	0.7	=	3.8	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.76	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	1.41	x	20.32	x	0.76	x	0.7	=	10.56	(74)
North	0.9x	0.77	x	0.97	x	20.32	x	0.76	x	0.7	=	7.27	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.76	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	1.41	x	34.53	x	0.76	x	0.7	=	17.95	(74)
North	0.9x	0.77	x	0.97	x	34.53	x	0.76	x	0.7	=	12.35	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.76	x	0.7	=	36.6	(74)
North	0.9x	0.77	x	1.41	x	55.46	x	0.76	x	0.7	=	28.83	(74)
North	0.9x	0.77	x	0.97	x	55.46	x	0.76	x	0.7	=	19.83	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.76	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	1.41	x	74.72	x	0.76	x	0.7	=	38.84	(74)
North	0.9x	0.77	x	0.97	x	74.72	x	0.76	x	0.7	=	26.72	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.76	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	1.41	x	79.99	x	0.76	x	0.7	=	41.58	(74)
North	0.9x	0.77	x	0.97	x	79.99	x	0.76	x	0.7	=	28.6	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.76	x	0.7	=	49.28	(74)
North	0.9x	0.77	x	1.41	x	74.68	x	0.76	x	0.7	=	38.82	(74)
North	0.9x	0.77	x	0.97	x	74.68	x	0.76	x	0.7	=	26.71	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.76	x	0.7	=	39.1	(74)
North	0.9x	0.77	x	1.41	x	59.25	x	0.76	x	0.7	=	30.8	(74)
North	0.9x	0.77	x	0.97	x	59.25	x	0.76	x	0.7	=	21.19	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.76	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.41	x	41.52	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	0.97	x	41.52	x	0.76	x	0.7	=	14.85	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.41	x	24.19	x	0.76	x	0.7	=	12.57	(74)
North	0.9x	0.77	x	0.97	x	24.19	x	0.76	x	0.7	=	8.65	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.76	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	1.41	x	13.12	x	0.76	x	0.7	=	6.82	(74)

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North	0.9x	0.77	x	0.97	x	13.12	x	0.76	x	0.7	=	4.69	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.76	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.41	x	8.86	x	0.76	x	0.7	=	4.61	(74)
North	0.9x	0.77	x	0.97	x	8.86	x	0.76	x	0.7	=	3.17	(74)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	2.19	x	19.64	x	0.76	x	0.7	=	15.86	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	2.19	x	38.42	x	0.76	x	0.7	=	31.02	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	2.19	x	63.27	x	0.76	x	0.7	=	51.09	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	2.19	x	92.28	x	0.76	x	0.7	=	74.51	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	2.19	x	113.09	x	0.76	x	0.7	=	91.31	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	2.19	x	115.77	x	0.76	x	0.7	=	93.47	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	2.19	x	110.22	x	0.76	x	0.7	=	88.99	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	2.19	x	94.68	x	0.76	x	0.7	=	76.44	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	2.19	x	73.59	x	0.76	x	0.7	=	59.42	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	2.19	x	45.59	x	0.76	x	0.7	=	36.81	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	2.19	x	24.49	x	0.76	x	0.7	=	19.77	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	2.19	x	16.15	x	0.76	x	0.7	=	13.04	(76)
South	0.9x	0.77	x	0.97	x	46.75	x	0.76	x	0.7	=	16.72	(78)

South	0.9x	0.77	x	0.97	x	76.57	x	0.76	x	0.7	=	27.38	(78)
South	0.9x	0.77	x	0.97	x	97.53	x	0.76	x	0.7	=	34.88	(78)
South	0.9x	0.77	x	0.97	x	110.23	x	0.76	x	0.7	=	39.42	(78)
South	0.9x	0.77	x	0.97	x	114.87	x	0.76	x	0.7	=	41.08	(78)
South	0.9x	0.77	x	0.97	x	110.55	x	0.76	x	0.7	=	39.53	(78)
South	0.9x	0.77	x	0.97	x	108.01	x	0.76	x	0.7	=	38.63	(78)
South	0.9x	0.77	x	0.97	x	104.89	x	0.76	x	0.7	=	37.51	(78)
South	0.9x	0.77	x	0.97	x	101.89	x	0.76	x	0.7	=	36.44	(78)
South	0.9x	0.77	x	0.97	x	82.59	x	0.76	x	0.7	=	29.53	(78)
South	0.9x	0.77	x	0.97	x	55.42	x	0.76	x	0.7	=	19.82	(78)
South	0.9x	0.77	x	0.97	x	40.4	x	0.76	x	0.7	=	14.45	(78)
West	0.9x	0.77	x	1.41	x	19.64	x	0.76	x	0.7	=	10.21	(80)
West	0.9x	0.77	x	3.52	x	19.64	x	0.76	x	0.7	=	25.49	(80)
West	0.9x	0.77	x	1.41	x	38.42	x	0.76	x	0.7	=	19.97	(80)
West	0.9x	0.77	x	3.52	x	38.42	x	0.76	x	0.7	=	49.86	(80)
West	0.9x	0.77	x	1.41	x	63.27	x	0.76	x	0.7	=	32.89	(80)
West	0.9x	0.77	x	3.52	x	63.27	x	0.76	x	0.7	=	82.11	(80)
West	0.9x	0.77	x	1.41	x	92.28	x	0.76	x	0.7	=	47.97	(80)
West	0.9x	0.77	x	3.52	x	92.28	x	0.76	x	0.7	=	119.76	(80)
West	0.9x	0.77	x	1.41	x	113.09	x	0.76	x	0.7	=	58.79	(80)
West	0.9x	0.77	x	3.52	x	113.09	x	0.76	x	0.7	=	146.76	(80)
West	0.9x	0.77	x	1.41	x	115.77	x	0.76	x	0.7	=	60.18	(80)
West	0.9x	0.77	x	3.52	x	115.77	x	0.76	x	0.7	=	150.24	(80)
West	0.9x	0.77	x	1.41	x	110.22	x	0.76	x	0.7	=	57.3	(80)
West	0.9x	0.77	x	3.52	x	110.22	x	0.76	x	0.7	=	143.03	(80)
West	0.9x	0.77	x	1.41	x	94.68	x	0.76	x	0.7	=	49.22	(80)
West	0.9x	0.77	x	3.52	x	94.68	x	0.76	x	0.7	=	122.86	(80)
West	0.9x	0.77	x	1.41	x	73.59	x	0.76	x	0.7	=	38.25	(80)
West	0.9x	0.77	x	3.52	x	73.59	x	0.76	x	0.7	=	95.5	(80)
West	0.9x	0.77	x	1.41	x	45.59	x	0.76	x	0.7	=	23.7	(80)
West	0.9x	0.77	x	3.52	x	45.59	x	0.76	x	0.7	=	59.16	(80)
West	0.9x	0.77	x	1.41	x	24.49	x	0.76	x	0.7	=	12.73	(80)
West	0.9x	0.77	x	3.52	x	24.49	x	0.76	x	0.7	=	31.78	(80)
West	0.9x	0.77	x	1.41	x	16.15	x	0.76	x	0.7	=	8.4	(80)
West	0.9x	0.77	x	3.52	x	16.15	x	0.76	x	0.7	=	20.96	(80)

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

(83)m=	110.54	210.19	337.57	488.72	602.08	619.2	588.23	502.08	390.56	246.56	136.59	91.79	(83)

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

(84)m=	735.69	830.52	934.08	1047.62	1122.35	1104.95	1054.31	977.73	888.26	782.1	713.42	699.98	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	0.99	0.98	0.96	0.88	0.72	0.52	0.38	0.42	0.68	0.92	0.98	0.99	(86)

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

(87)m=	20.15	20.3	20.54	20.8	20.95	20.99	21	21	20.97	20.76	20.41	20.12	(87)

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

(88)m=	20.09	20.1	20.1	20.11	20.11	20.12	20.12	20.12	20.11	20.11	20.11	20.1	(88)

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

(89)m=	0.99	0.98	0.95	0.84	0.66	0.45	0.3	0.34	0.6	0.89	0.98	0.99	(89)

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

(90)m=	18.97	19.19	19.53	19.89	20.06	20.11	20.12	20.12	20.09	19.85	19.35	18.93	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.42	19.62	19.91	20.24	20.4	20.45	20.46	20.46	20.43	20.2	19.76	19.39	(92)

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

(93)m=	19.27	19.47	19.76	20.09	20.25	20.3	20.31	20.31	20.28	20.05	19.61	19.24	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.94	0.84	0.67	0.47	0.32	0.36	0.62	0.89	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	726.57	810.22	879.33	884.46	751.78	514	335.99	353.16	547.91	697.98	695.52	693.15	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1400.55	1358.85	1234.17	1028.55	784.5	517.32	336.28	353.76	563.21	866.69	1152.52	1392.42	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	501.44	368.68	264	103.75	24.35	0	0	0	0	125.52	329.04	520.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2237.03 (98)

Space heating requirement in kWh/m²/year 23.64 (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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	501.44	368.68	264	103.75	24.35	0	0	0	0	125.52	329.04	520.25	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	552.25	406.04	290.75	114.26	26.81	0	0	0	0	138.23	362.38	572.97	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2463.69 (211)

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

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

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

Water heating

Output from water heater (calculated above)

210.73	185.76	195.1	173.04	167.54	147.56	141.37	157.6	159.34	181.44	191.8	205.69

Efficiency of water heater 81.5 (216)

(217)m=	87.83	87.46	86.6	84.75	82.57	81.5	81.5	81.5	81.5	85.06	87.14	87.96	(217)

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

(219)m=	239.91	212.4	225.29	204.17	202.9	181.05	173.46	193.37	195.51	213.3	220.11	233.85

Total = Sum(219a)$_{1...12}$ = 2495.32 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2463.69	
Water heating fuel used		2495.32	
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		402.74	(232)
Electricity generated by PVs		-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	85.74	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	86.84	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	53.12	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)

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

Total energy cost (245)...(247) + (250)…(254) = 270.15 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.81	(257)

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SAP rating (Section 12)			88.66	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	532.16	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	538.99	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1071.15	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	209.02	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		982.93	(272)
CO2 emissions per m²		(272) ÷ (4) =		10.39	(273)
EI rating (section 14)				91	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3005.7	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3044.29	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6050	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1236.42	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1988.48	(269)
'Total Primary Energy		sum of (265)…(271) =		5528.18	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		58.43	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 5

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	108.62	(1a) x	2.7	(2a) =	293.27	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	108.62	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	293.27	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.14	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.34	(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) =	0.29	(21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(24d)

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

(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 2			3.52	x1/[1/(1.1)+ 0.04]		=	3.71			(27)
Windows Type 3			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 4			1.1	x1/[1/(1.1)+ 0.04]		=	1.16			(27)
Windows Type 5			1.1	x1/[1/(1.1)+ 0.04]		=	1.16			(27)
Windows Type 6			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 7			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 8			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Walls Type1	25.51	1.79	23.72	x	0.13	=	3.08			(29)
Walls Type2	49.41	5.72	43.69	x	0.13	=	5.68			(29)
Walls Type3	20.79	5.37	15.42	x	0.13	=	2			(29)
Walls Type4	29.3	2.3	27	x	0.12	=	3.17			(29)
Walls Type5	6.34	1.79	4.55	x	0.13	=	0.59			(29)
Roof	13	0	13	x	0.1	=	1.3			(30)
Total area of elements, m²			144.36							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 34.51 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 21850.15 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 11.98 | (36)

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

Total fabric heat loss (33) + (36) = | 46.49 | (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=	54.82	54.57	54.33	53.18	52.96	51.96	51.96	51.78	52.35	52.96	53.4	53.85	(38)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(39)m=	101.31	101.06	100.82	99.67	99.45	98.45	98.45	98.27	98.84	99.45	99.89	100.34

Average = Sum(39)$_{1…12}$ /12= | 99.67 | (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	0.93	0.93	0.93	0.92	0.92	0.91	0.91	0.9	0.91	0.92	0.92	0.92

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 | 2.81 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 100.85 | (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	110.93	106.9	102.87	98.83	94.8	90.76	90.76	94.8	98.83	102.87	106.9	110.93

Total = Sum(44)$_{1…12}$ = | 1210.19 | (44)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(45)m=	164.51	143.88	148.47	129.44	124.2	107.18	99.32	113.97	115.33	134.4	146.71	159.32

Total = Sum(45)$_{1…12}$ = | 1586.75 | (45)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	24.68	21.58	22.27	19.42	18.63	16.08	14.9	17.1	17.3	20.16	22.01	23.9	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.96	48.74	48.31	44.76	46.25	48.31	48.74	50.96	49.32	50.96	(61)

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

(62)m=	215.47	189.91	199.43	178.18	172.51	151.94	145.57	162.28	164.07	185.36	196.03	210.28	(62)

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

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

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

Output from water heater

(64)m=	215.47	189.91	199.43	178.18	172.51	151.94	145.57	162.28	164.07	185.36	196.03	210.28

Output from water heater (annual)$_{1...12}$ 2171.04 (64)

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

(65)m=	67.44	59.35	62.11	55.22	53.38	46.83	44.59	49.97	50.53	57.43	61.11	65.71	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	168.38	168.38	168.38	168.38	168.38	168.38	168.38	168.38	168.38	168.38	168.38	168.38	(66)

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

(67)m=	64.96	57.7	46.92	35.52	26.55	22.42	24.22	31.49	42.26	53.66	62.63	66.77	(67)

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

(68)m=	402.33	406.5	395.98	373.58	345.31	318.74	300.99	296.81	307.33	329.73	358	384.57	(68)

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

(69)m=	54.64	54.64	54.64	54.64	54.64	54.64	54.64	54.64	54.64	54.64	54.64	54.64	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	-112.25	(71)

Water heating gains (Table 5)

(72)m=	90.65	88.32	83.48	76.7	71.74	65.04	59.93	67.17	70.18	77.19	84.88	88.33	(72)

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

(73)m=	671.7	666.28	640.15	599.58	557.38	519.96	498.91	509.24	533.55	574.35	619.28	653.44	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.79	x	10.63	x	0.76	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.76	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.76	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.76	x	0.7	=	36.6	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.76	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.76	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.76	x	0.7	=	49.28	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.76	x	0.7	=	39.1	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.76	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.76	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.76	x	0.7	=	5.85	(74)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)

East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
South	0.9x	0.77	x	3.52	x	46.75	x	0.76	x	0.7	=	60.67	(78)
South	0.9x	0.77	x	1.1	x	46.75	x	0.76	x	0.7	=	18.96	(78)
South	0.9x	0.77	x	1.1	x	46.75	x	0.76	x	0.7	=	18.96	(78)
South	0.9x	0.77	x	3.52	x	76.57	x	0.76	x	0.7	=	99.37	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.76	x	0.7	=	31.05	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.76	x	0.7	=	31.05	(78)
South	0.9x	0.77	x	3.52	x	97.53	x	0.76	x	0.7	=	126.57	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.76	x	0.7	=	39.55	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.76	x	0.7	=	39.55	(78)
South	0.9x	0.77	x	3.52	x	110.23	x	0.76	x	0.7	=	143.06	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.76	x	0.7	=	44.7	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.76	x	0.7	=	44.7	(78)
South	0.9x	0.77	x	3.52	x	114.87	x	0.76	x	0.7	=	149.07	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.76	x	0.7	=	46.59	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.76	x	0.7	=	46.59	(78)
South	0.9x	0.77	x	3.52	x	110.55	x	0.76	x	0.7	=	143.46	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.76	x	0.7	=	44.83	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.76	x	0.7	=	44.83	(78)
South	0.9x	0.77	x	3.52	x	108.01	x	0.76	x	0.7	=	140.17	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.76	x	0.7	=	43.8	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.76	x	0.7	=	43.8	(78)
South	0.9x	0.77	x	3.52	x	104.89	x	0.76	x	0.7	=	136.13	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.76	x	0.7	=	42.54	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.76	x	0.7	=	42.54	(78)
South	0.9x	0.77	x	3.52	x	101.89	x	0.76	x	0.7	=	132.22	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.76	x	0.7	=	41.32	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.76	x	0.7	=	41.32	(78)
South	0.9x	0.77	x	3.52	x	82.59	x	0.76	x	0.7	=	107.17	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.76	x	0.7	=	33.49	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.76	x	0.7	=	33.49	(78)
South	0.9x	0.77	x	3.52	x	55.42	x	0.76	x	0.7	=	71.92	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.76	x	0.7	=	22.47	(78)

South	0.9x	0.77	x	1.1	x	55.42	x	0.76	x	0.7	=	22.47	(78)
South	0.9x	0.77	x	3.52	x	40.4	x	0.76	x	0.7	=	52.43	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.76	x	0.7	=	16.38	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.76	x	0.7	=	16.38	(78)
West	0.9x	0.77	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(80)
West	0.9x	0.77	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(80)
West	0.9x	0.77	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(80)
West	0.9x	0.77	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(80)
West	0.9x	0.77	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(80)
West	0.9x	0.77	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(80)
West	0.9x	0.77	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(80)
West	0.9x	0.77	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(80)
West	0.9x	0.77	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(80)
West	0.9x	0.77	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(80)
West	0.9x	0.77	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(80)

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

(83)m=	157.45	276.3	395.49	512.66	590.08	591.51	568.01	510.22	436.51	310.46	190.17	133.68	(83)

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

(84)m=	829.16	942.58	1035.64	1112.24	1147.46	1111.48	1066.91	1019.46	970.06	884.82	809.45	787.11	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.89	0.75	0.56	0.41	0.44	0.68	0.92	0.98	0.99	(86)

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

(87)m=	20.22	20.37	20.58	20.81	20.94	20.99	21	21	20.98	20.8	20.47	20.19	(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	20.16	20.16	20.16	20.16	20.15	20.15	20.15	(88)

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

(89)m=	0.99	0.98	0.95	0.86	0.7	0.49	0.33	0.36	0.6	0.89	0.98	0.99	(89)

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

(90)m=	19.11	19.33	19.62	19.94	20.1	20.16	20.16	20.16	20.14	19.94	19.47	19.07	(90)

fLA = Living area ÷ (4) = 0.3 (91)

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

(92)m=	19.44	19.64	19.91	20.2	20.36	20.41	20.41	20.41	20.39	20.19	19.77	19.4	(92)

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

(93)m=	19.29	19.49	19.76	20.05	20.21	20.26	20.26	20.26	20.24	20.04	19.62	19.25	(93)

8. Space heating requirement

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

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

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Utilisation factor for gains, hm:

(94)m=	0.99	0.97	0.94	0.86	0.7	0.5	0.34	0.37	0.61	0.88	0.97	0.99	(94)

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

(95)m=	818.81	918.04	974.84	953.86	806.22	552.9	360.32	379.1	593.55	780.92	787.76	779.54	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1518.7	1474.47	1336.85	1111.05	845.91	557.02	360.63	379.67	607.14	939.26	1250.76	1510.37	(97)

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

(98)m=	520.72	373.92	269.34	113.17	29.53	0	0	0	0	117.81	333.36	543.74

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2301.59 (98)

Space heating requirement in kWh/m²/year 21.19 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	520.72	373.92	269.34	113.17	29.53	0	0	0	0	117.81	333.36	543.74	
(211)m = {[(98)m x (204)] } x 100 ÷ (206) (211)	573.48	411.81	296.63	124.64	32.52	0	0	0	0	129.74	367.13	598.83	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2534.79 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

Water heating

Output from water heater (calculated above)

215.47	189.91	199.43	178.18	172.51	151.94	145.57	162.28	164.07	185.36	196.03	210.28

Efficiency of water heater 81.5 (216)

(217)m=	87.87	87.44	86.6	84.88	82.74	81.5	81.5	81.5	81.5	84.88	87.12	88	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	245.23	217.19	230.3	209.93	208.5	186.43	178.61	199.11	201.31	218.39	225.01	238.96

Total = Sum(219a)$_{1...12}$ = 2558.98 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		2534.79
Water heating fuel used		2558.98
Electricity for pumps, fans and electric keep-hot		

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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			458.9	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	88.21	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	89.05	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	60.53	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			282.25	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.77	(257)
SAP rating (Section 12)		89.24	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	547.51	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	552.74	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1100.25	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	238.17	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		1041.18	(272)
CO2 emissions per m²		(272) ÷ (4) =		9.59	(273)

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EI rating (section 14)				91	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3092.44	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3121.95	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6214.39	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1408.82	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1988.48	(269)
'Total Primary Energy		sum of (265)…(271) =		5864.98	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		54	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 6

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	94.61	(1a) x	2.7	(2a) =	255.45	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	94.61	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	255.45	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.12	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.32	(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) =	0.27	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.34	0.34	0.33	0.3	0.29	0.26	0.26	0.25	0.27	0.29	0.3	0.32

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			1.41	x1/[1/(1.1)+ 0.04]		=	1.49			(27)
Windows Type 2			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 3			1.41	x1/[1/(1.1)+ 0.04]		=	1.49			(27)
Windows Type 4			3.52	x1/[1/(1.1)+ 0.04]		=	3.71			(27)
Windows Type 5			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 6			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 7			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Walls Type1	24.7	4.93	19.77	x	0.13	=	2.57			(29)
Walls Type2	43.09	3.2	39.89	x	0.13	=	5.19			(29)
Walls Type3	23.35	5.37	17.98	x	0.13	=	2.34			(29)
Walls Type4	42.66	2.3	40.36	x	0.12	=	4.74			(29)
Roof	14.61	0	14.61	x	0.1	=	1.46			(30)
Total area of elements, m²			148.42							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 33.74 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 22553.77 (34)

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

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f

can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K | 10.63 | (36)

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

Total fabric heat loss (33) + (36) = | 44.37 | (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	47.14	46.94	46.75	45.86	45.69	44.92	44.92	44.77	45.22	45.69	46.03	46.39	(38)

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

(39)m=	91.51	91.32	91.13	90.24	90.07	89.29	89.29	89.15	89.59	90.07	90.41	90.76	

Average = Sum(39)$_{1...12}$ /12= | 90.24 | (39)

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

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

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

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 2.68 | (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 97.94 | (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	107.73	103.81	99.9	95.98	92.06	88.14	88.14	92.06	95.98	99.9	103.81	107.73	

Total = Sum(44)$_{1...12}$ = | 1175.26 | (44)

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

(45)m=	159.76	139.73	144.19	125.71	120.62	104.09	96.45	110.68	112	130.53	142.48	154.72	

Total = Sum(45)$_{1...12}$ = | 1540.95 | (45)

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

(46)m=	23.96	20.96	21.63	18.86	18.09	15.61	14.47	16.6	16.8	19.58	21.37	23.21	(46)

Water storage loss:

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

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

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

Water storage loss:

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

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

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

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

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

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.91	47.33	46.91	43.47	44.92	46.91	47.33	50.91	49.32	50.96	(61)

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

(62)m=	210.72	185.76	195.1	173.04	167.53	147.55	141.37	157.59	159.33	181.43	191.79	205.68	(62)

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

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

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

Output from water heater

(64)m=	210.72	185.76	195.1	173.04	167.53	147.55	141.37	157.59	159.33	181.43	191.79	205.68

Output from water heater (annual)$_{1...12}$ 2116.9 (64)

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

(65)m=	65.86	57.97	60.67	53.63	51.83	45.48	43.3	48.53	49.07	56.13	59.7	64.18	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	161.02	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	58.89	52.3	42.54	32.2	24.07	20.32	21.96	28.54	38.31	48.65	56.78	60.53	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	369.12	372.95	363.29	342.75	316.81	292.43	276.14	272.31	281.96	302.51	328.45	352.83	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	53.79	(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=	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	-107.35	(71)
Water heating gains (Table 5)													
(72)m=	88.52	86.26	81.54	74.49	69.67	63.16	58.2	65.23	68.16	75.44	82.92	86.27	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	626.99	621.97	597.84	559.9	521.01	486.37	466.76	476.54	498.89	537.06	578.61	610.09	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.79	x	10.63	x	0.76	x	0.7	=	7.02	(74)
North	0.9x	0.77	x	1.41	x	10.63	x	0.76	x	0.7	=	5.53	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.76	x	0.7	=	13.41	(74)
North	0.9x	0.77	x	1.41	x	20.32	x	0.76	x	0.7	=	10.56	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.76	x	0.7	=	22.79	(74)
North	0.9x	0.77	x	1.41	x	34.53	x	0.76	x	0.7	=	17.95	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.76	x	0.7	=	36.6	(74)
North	0.9x	0.77	x	1.41	x	55.46	x	0.76	x	0.7	=	28.83	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.76	x	0.7	=	49.31	(74)
North	0.9x	0.77	x	1.41	x	74.72	x	0.76	x	0.7	=	38.84	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.76	x	0.7	=	52.78	(74)
North	0.9x	0.77	x	1.41	x	79.99	x	0.76	x	0.7	=	41.58	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.76	x	0.7	=	49.28	(74)
North	0.9x	0.77	x	1.41	x	74.68	x	0.76	x	0.7	=	38.82	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.76	x	0.7	=	39.1	(74)
North	0.9x	0.77	x	1.41	x	59.25	x	0.76	x	0.7	=	30.8	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.76	x	0.7	=	27.4	(74)
North	0.9x	0.77	x	1.41	x	41.52	x	0.76	x	0.7	=	21.58	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.76	x	0.7	=	15.96	(74)
North	0.9x	0.77	x	1.41	x	24.19	x	0.76	x	0.7	=	12.57	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.76	x	0.7	=	8.66	(74)
North	0.9x	0.77	x	1.41	x	13.12	x	0.76	x	0.7	=	6.82	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.76	x	0.7	=	5.85	(74)
North	0.9x	0.77	x	1.41	x	8.86	x	0.76	x	0.7	=	4.61	(74)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)

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East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
West	0.9x	0.77	x	1.41	x	19.64	x	0.76	x	0.7	=	10.21	(80)
West	0.9x	0.77	x	3.52	x	19.64	x	0.76	x	0.7	=	25.49	(80)
West	0.9x	0.77	x	1.41	x	38.42	x	0.76	x	0.7	=	19.97	(80)
West	0.9x	0.77	x	3.52	x	38.42	x	0.76	x	0.7	=	49.86	(80)
West	0.9x	0.77	x	1.41	x	63.27	x	0.76	x	0.7	=	32.89	(80)
West	0.9x	0.77	x	3.52	x	63.27	x	0.76	x	0.7	=	82.11	(80)
West	0.9x	0.77	x	1.41	x	92.28	x	0.76	x	0.7	=	47.97	(80)
West	0.9x	0.77	x	3.52	x	92.28	x	0.76	x	0.7	=	119.76	(80)
West	0.9x	0.77	x	1.41	x	113.09	x	0.76	x	0.7	=	58.79	(80)
West	0.9x	0.77	x	3.52	x	113.09	x	0.76	x	0.7	=	146.76	(80)
West	0.9x	0.77	x	1.41	x	115.77	x	0.76	x	0.7	=	60.18	(80)
West	0.9x	0.77	x	3.52	x	115.77	x	0.76	x	0.7	=	150.24	(80)
West	0.9x	0.77	x	1.41	x	110.22	x	0.76	x	0.7	=	57.3	(80)
West	0.9x	0.77	x	3.52	x	110.22	x	0.76	x	0.7	=	143.03	(80)
West	0.9x	0.77	x	1.41	x	94.68	x	0.76	x	0.7	=	49.22	(80)
West	0.9x	0.77	x	3.52	x	94.68	x	0.76	x	0.7	=	122.86	(80)
West	0.9x	0.77	x	1.41	x	73.59	x	0.76	x	0.7	=	38.25	(80)
West	0.9x	0.77	x	3.52	x	73.59	x	0.76	x	0.7	=	95.5	(80)
West	0.9x	0.77	x	1.41	x	45.59	x	0.76	x	0.7	=	23.7	(80)
West	0.9x	0.77	x	3.52	x	45.59	x	0.76	x	0.7	=	59.16	(80)

West	0.9x	0.77	x	1.41	x	24.49	x	0.76	x	0.7	=	12.73	(80)
West	0.9x	0.77	x	3.52	x	24.49	x	0.76	x	0.7	=	31.78	(80)
West	0.9x	0.77	x	1.41	x	16.15	x	0.76	x	0.7	=	8.4	(80)
West	0.9x	0.77	x	3.52	x	16.15	x	0.76	x	0.7	=	20.96	(80)

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

(83)m=	87.13	169.87	281.01	415.86	517.6	533.99	506.64	429.42	328.42	201.66	108.47	71.79	(83)

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

(84)m=	714.12	791.84	878.85	975.75	1038.61	1020.36	973.4	905.96	827.32	738.71	687.08	681.88	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.9	0.75	0.55	0.4	0.45	0.71	0.93	0.99	0.99	(86)

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

(87)m=	20.16	20.29	20.52	20.78	20.94	20.99	21	21	20.97	20.75	20.4	20.13	(87)

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

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

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

(89)m=	0.99	0.98	0.96	0.87	0.7	0.48	0.32	0.37	0.63	0.91	0.98	0.99	(89)

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

(90)m=	19	19.19	19.51	19.87	20.07	20.13	20.13	20.13	20.1	19.84	19.36	18.96	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.43	19.61	19.89	20.21	20.39	20.45	20.46	20.46	20.43	20.18	19.75	19.4	(92)

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

(93)m=	19.28	19.46	19.74	20.06	20.24	20.3	20.31	20.31	20.28	20.03	19.6	19.25	(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	0.87	0.7	0.49	0.34	0.38	0.65	0.91	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	706.17	775.46	835.96	846.31	730.2	504.75	330.55	347.48	535.12	669.88	671.9	675.86	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1371.27	1329.22	1206.39	1007.33	769.63	508.98	330.92	348.23	553.44	849.56	1130.42	1365.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	494.83	372.13	275.6	115.93	29.33	0	0	0	0	133.68	330.13	513.41	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 2265.04 (98)

Space heating requirement in kWh/m²/year 23.94 (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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	494.83	372.13	275.6	115.93	29.33	0	0	0	0	133.68	330.13	513.41		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	544.97	409.83	303.52	127.68	32.3	0	0	0	0	147.23	363.58	565.43		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2494.54	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)
Water heating														
Output from water heater (calculated above)	210.72	185.76	195.1	173.04	167.53	147.55	141.37	157.59	159.33	181.43	191.79	205.68		
Efficiency of water heater													81.5	(216)
(217)m=	87.81	87.48	86.7	84.99	82.76	81.5	81.5	81.5	81.5	85.2	87.15	87.93		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	239.98	212.35	225.03	203.59	202.43	181.05	173.46	193.36	195.5	212.94	220.08	233.91		
Total = Sum(219a)$_{1...12}$ =													2493.69	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2494.54	
Water heating fuel used			2493.69	
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			416	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	86.81	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)

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Water heating cost (other fuel)	(219)	3.48	x 0.01 =	86.78	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	54.87	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			272.92	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.82	(257)
SAP rating (Section 12)		88.55	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	538.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	538.64	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1077.46	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	215.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		996.12	(272)
CO2 emissions per m²		(272) ÷ (4) =		10.53	(273)
EI rating (section 14)				90	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3043.34	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3042.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6085.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1277.13	(268)
Energy saving/generation technologies Item 1		3.07	=	-1988.48	(269)

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‘Total Primary Energy	sum of (265)…(271) =	5604.53	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =	59.24	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 7

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	91.09	(1a) x	2.7	(2a) =	245.94	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	91.09	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	245.94	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							4	x 10 =	40	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40	÷ (5) =	0.16	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.36	(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) =	0.31	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.39	0.39	0.38	0.34	0.33	0.29	0.29	0.29	0.31	0.33	0.35	0.36

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.3	x	1.4	=	3.22			(26)
Windows Type 1			4.61	x1/[1/(1.1)+ 0.04]		=	4.86			(27)
Windows Type 2			1.11	x1/[1/(1.1)+ 0.04]		=	1.17			(27)
Windows Type 3			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 4			1.1	x1/[1/(1.1)+ 0.04]		=	1.16			(27)
Windows Type 5			0.99	x1/[1/(1.1)+ 0.04]		=	1.04			(27)
Windows Type 6			2.19	x1/[1/(1.1)+ 0.04]		=	2.31			(27)
Windows Type 7			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 8			1.79	x1/[1/(1.1)+ 0.04]		=	1.89			(27)
Windows Type 9			0.99	x1/[1/(1.1)+ 0.04]		=	1.04			(27)
Floor			0.566	x	0.09	=	0.05094			(28)
Walls Type1	19.14	6.4	12.74	x	0.13	=	1.66			(29)
Walls Type2	42.66	3.2	39.46	x	0.13	=	5.13			(29)
Walls Type3	20.79	5.77	15.02	x	0.13	=	1.95			(29)
Walls Type4	29.3	2.3	27	x	0.12	=	3.17			(29)
Walls Type5	0.99	0.99	0	x	0.13	=	0			(29)
Roof	0.57	0	0.57	x	0.1	=	0.06			(30)
Total area of elements, m²			114.01							(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 32.48 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17948.58	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		11.05	(36)

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

Total fabric heat loss	(33) + (36) =	43.52	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	46.85	46.61	46.37	45.25	45.04	44.06	44.06	43.88	44.44	45.04	45.46	45.9	(38)

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

(39)m=	90.37	90.13	89.89	88.77	88.56	87.58	87.58	87.4	87.96	88.56	88.98	89.43	

Average = Sum(39)$_{1…12}$ /12= 88.77 (39)

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

(40)m=	0.99	0.99	0.99	0.97	0.97	0.96	0.96	0.96	0.97	0.97	0.98	0.98

Average = Sum(40)$_{1…12}$ /12= 0.97 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.64 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 96.91 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)												
(44)m=	106.6	102.72	98.85	94.97	91.09	87.22	87.22	91.09	94.97	98.85	102.72	106.6

Total = Sum(44)$_{1…12}$ = 1162.9 (44)

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

(45)m=	158.08	138.26	142.67	124.39	119.35	102.99	95.44	109.51	110.82	129.15	140.98	153.1

Total = Sum(45)$_{1…12}$ = 1524.74 (45)

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

(46)m=	23.71	20.74	21.4	18.66	17.9	15.45	14.32	16.43	16.62	19.37	21.15	22.96	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
If community heating see section 4.3		
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)	0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	50.96	46.03	50.37	46.83	46.42	43.01	44.45	46.42	46.83	50.37	49.32	50.96	(61)

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

(62)m=	209.04	184.29	193.04	171.22	165.77	146	139.88	155.93	157.66	179.52	190.3	204.05	(62)

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

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

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

Output from water heater

(64)m=	209.04	184.29	193.04	171.22	165.77	146	139.88	155.93	157.66	179.52	190.3	204.05

Output from water heater (annual)$_{1...12}$ — 2096.71 (64)

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

(65)m=	65.3	57.48	60.03	53.07	51.29	45	42.84	48.02	48.56	55.54	59.2	63.64	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	158.42	158.42	158.42	158.42	158.42	158.42	158.42	158.42	158.42	158.42	158.42	158.42	(66)

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

(67)m=	54.9	48.76	39.65	30.02	22.44	18.94	20.47	26.61	35.71	45.35	52.93	56.42	(67)

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

(68)m=	359.8	363.54	354.13	334.1	308.82	285.05	269.18	265.44	274.85	294.88	320.17	343.93	(68)

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

(69)m=	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	53.48	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	-105.61	(71)

Water heating gains (Table 5)

(72)m=	87.77	85.53	80.69	73.7	68.94	62.5	57.59	64.54	67.44	74.65	82.23	85.54	(72)

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

(73)m=	611.76	607.12	583.76	547.11	509.48	475.78	456.52	465.88	487.29	524.16	564.61	595.18	(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	0.99	x	10.63	x	0.76	x	0.7	=	3.88	(74)
North	0.9x	0.77	x	0.99	x	20.32	x	0.76	x	0.7	=	7.42	(74)
North	0.9x	0.77	x	0.99	x	34.53	x	0.76	x	0.7	=	12.6	(74)
North	0.9x	0.77	x	0.99	x	55.46	x	0.76	x	0.7	=	20.24	(74)
North	0.9x	0.77	x	0.99	x	74.72	x	0.76	x	0.7	=	27.27	(74)
North	0.9x	0.77	x	0.99	x	79.99	x	0.76	x	0.7	=	29.19	(74)
North	0.9x	0.77	x	0.99	x	74.68	x	0.76	x	0.7	=	27.26	(74)
North	0.9x	0.77	x	0.99	x	59.25	x	0.76	x	0.7	=	21.62	(74)
North	0.9x	0.77	x	0.99	x	41.52	x	0.76	x	0.7	=	15.15	(74)
North	0.9x	0.77	x	0.99	x	24.19	x	0.76	x	0.7	=	8.83	(74)
North	0.9x	0.77	x	0.99	x	13.12	x	0.76	x	0.7	=	4.79	(74)
North	0.9x	0.77	x	0.99	x	8.86	x	0.76	x	0.7	=	3.24	(74)
East	0.9x	1	x	2.19	x	19.64	x	0.76	x	0.7	=	15.86	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(76)
East	0.9x	1	x	2.19	x	38.42	x	0.76	x	0.7	=	31.02	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(76)
East	0.9x	1	x	2.19	x	63.27	x	0.76	x	0.7	=	51.09	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(76)
East	0.9x	1	x	2.19	x	92.28	x	0.76	x	0.7	=	74.51	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(76)
East	0.9x	1	x	2.19	x	113.09	x	0.76	x	0.7	=	91.31	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(76)
East	0.9x	1	x	2.19	x	115.77	x	0.76	x	0.7	=	93.47	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(76)
East	0.9x	1	x	2.19	x	110.22	x	0.76	x	0.7	=	88.99	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(76)
East	0.9x	1	x	2.19	x	94.68	x	0.76	x	0.7	=	76.44	(76)

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East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(76)
East	0.9x	1	x	2.19	x	73.59	x	0.76	x	0.7	=	59.42	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(76)
East	0.9x	1	x	2.19	x	45.59	x	0.76	x	0.7	=	36.81	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(76)
East	0.9x	1	x	2.19	x	24.49	x	0.76	x	0.7	=	19.77	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(76)
East	0.9x	1	x	2.19	x	16.15	x	0.76	x	0.7	=	13.04	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
East	0.9x	1	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(76)
South	0.9x	0.77	x	1.11	x	46.75	x	0.76	x	0.7	=	19.13	(78)
South	0.9x	0.77	x	1.1	x	46.75	x	0.76	x	0.7	=	18.96	(78)
South	0.9x	0.77	x	0.99	x	46.75	x	0.76	x	0.7	=	17.06	(78)
South	0.9x	0.77	x	1.11	x	76.57	x	0.76	x	0.7	=	31.33	(78)
South	0.9x	0.77	x	1.1	x	76.57	x	0.76	x	0.7	=	31.05	(78)
South	0.9x	0.77	x	0.99	x	76.57	x	0.76	x	0.7	=	27.95	(78)
South	0.9x	0.77	x	1.11	x	97.53	x	0.76	x	0.7	=	39.91	(78)
South	0.9x	0.77	x	1.1	x	97.53	x	0.76	x	0.7	=	39.55	(78)
South	0.9x	0.77	x	0.99	x	97.53	x	0.76	x	0.7	=	35.6	(78)
South	0.9x	0.77	x	1.11	x	110.23	x	0.76	x	0.7	=	45.11	(78)
South	0.9x	0.77	x	1.1	x	110.23	x	0.76	x	0.7	=	44.7	(78)
South	0.9x	0.77	x	0.99	x	110.23	x	0.76	x	0.7	=	40.23	(78)
South	0.9x	0.77	x	1.11	x	114.87	x	0.76	x	0.7	=	47.01	(78)
South	0.9x	0.77	x	1.1	x	114.87	x	0.76	x	0.7	=	46.59	(78)
South	0.9x	0.77	x	0.99	x	114.87	x	0.76	x	0.7	=	41.93	(78)
South	0.9x	0.77	x	1.11	x	110.55	x	0.76	x	0.7	=	45.24	(78)
South	0.9x	0.77	x	1.1	x	110.55	x	0.76	x	0.7	=	44.83	(78)
South	0.9x	0.77	x	0.99	x	110.55	x	0.76	x	0.7	=	40.35	(78)
South	0.9x	0.77	x	1.11	x	108.01	x	0.76	x	0.7	=	44.2	(78)
South	0.9x	0.77	x	1.1	x	108.01	x	0.76	x	0.7	=	43.8	(78)
South	0.9x	0.77	x	0.99	x	108.01	x	0.76	x	0.7	=	39.42	(78)
South	0.9x	0.77	x	1.11	x	104.89	x	0.76	x	0.7	=	42.93	(78)
South	0.9x	0.77	x	1.1	x	104.89	x	0.76	x	0.7	=	42.54	(78)
South	0.9x	0.77	x	0.99	x	104.89	x	0.76	x	0.7	=	38.29	(78)
South	0.9x	0.77	x	1.11	x	101.89	x	0.76	x	0.7	=	41.69	(78)
South	0.9x	0.77	x	1.1	x	101.89	x	0.76	x	0.7	=	41.32	(78)
South	0.9x	0.77	x	0.99	x	101.89	x	0.76	x	0.7	=	37.19	(78)

South	0.9x	0.77	x	1.11	x	82.59	x	0.76	x	0.7	=	33.8	(78)
South	0.9x	0.77	x	1.1	x	82.59	x	0.76	x	0.7	=	33.49	(78)
South	0.9x	0.77	x	0.99	x	82.59	x	0.76	x	0.7	=	30.14	(78)
South	0.9x	0.77	x	1.11	x	55.42	x	0.76	x	0.7	=	22.68	(78)
South	0.9x	0.77	x	1.1	x	55.42	x	0.76	x	0.7	=	22.47	(78)
South	0.9x	0.77	x	0.99	x	55.42	x	0.76	x	0.7	=	20.23	(78)
South	0.9x	0.77	x	1.11	x	40.4	x	0.76	x	0.7	=	16.53	(78)
South	0.9x	0.77	x	1.1	x	40.4	x	0.76	x	0.7	=	16.38	(78)
South	0.9x	0.77	x	0.99	x	40.4	x	0.76	x	0.7	=	14.74	(78)
West	0.9x	0.77	x	4.61	x	19.64	x	0.76	x	0.7	=	33.38	(80)
West	0.9x	0.77	x	1.79	x	19.64	x	0.76	x	0.7	=	12.96	(80)
West	0.9x	0.77	x	4.61	x	38.42	x	0.76	x	0.7	=	65.3	(80)
West	0.9x	0.77	x	1.79	x	38.42	x	0.76	x	0.7	=	25.35	(80)
West	0.9x	0.77	x	4.61	x	63.27	x	0.76	x	0.7	=	107.54	(80)
West	0.9x	0.77	x	1.79	x	63.27	x	0.76	x	0.7	=	41.76	(80)
West	0.9x	0.77	x	4.61	x	92.28	x	0.76	x	0.7	=	156.84	(80)
West	0.9x	0.77	x	1.79	x	92.28	x	0.76	x	0.7	=	60.9	(80)
West	0.9x	0.77	x	4.61	x	113.09	x	0.76	x	0.7	=	192.21	(80)
West	0.9x	0.77	x	1.79	x	113.09	x	0.76	x	0.7	=	74.63	(80)
West	0.9x	0.77	x	4.61	x	115.77	x	0.76	x	0.7	=	196.76	(80)
West	0.9x	0.77	x	1.79	x	115.77	x	0.76	x	0.7	=	76.4	(80)
West	0.9x	0.77	x	4.61	x	110.22	x	0.76	x	0.7	=	187.33	(80)
West	0.9x	0.77	x	1.79	x	110.22	x	0.76	x	0.7	=	72.74	(80)
West	0.9x	0.77	x	4.61	x	94.68	x	0.76	x	0.7	=	160.91	(80)
West	0.9x	0.77	x	1.79	x	94.68	x	0.76	x	0.7	=	62.48	(80)
West	0.9x	0.77	x	4.61	x	73.59	x	0.76	x	0.7	=	125.07	(80)
West	0.9x	0.77	x	1.79	x	73.59	x	0.76	x	0.7	=	48.56	(80)
West	0.9x	0.77	x	4.61	x	45.59	x	0.76	x	0.7	=	77.48	(80)
West	0.9x	0.77	x	1.79	x	45.59	x	0.76	x	0.7	=	30.09	(80)
West	0.9x	0.77	x	4.61	x	24.49	x	0.76	x	0.7	=	41.62	(80)
West	0.9x	0.77	x	1.79	x	24.49	x	0.76	x	0.7	=	16.16	(80)
West	0.9x	0.77	x	4.61	x	16.15	x	0.76	x	0.7	=	27.45	(80)
West	0.9x	0.77	x	1.79	x	16.15	x	0.76	x	0.7	=	10.66	(80)

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

(83)m=	147.16	270.13	411.56	564.34	670.21	679.05	649.21	570.17	465.53	310.81	180.04	123.36	(83)

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

(84)m=	758.92	877.25	995.32	1111.45	1179.7	1154.83	1105.73	1036.05	952.83	834.97	744.65	718.54	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	0.99	0.98	0.94	0.84	0.67	0.48	0.35	0.39	0.62	0.89	0.98	0.99	(86)

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

(87)m=	20.2	20.37	20.61	20.85	20.96	21	21	21	20.98	20.81	20.46	20.16	(87)

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

(88)m=	20.09	20.09	20.09	20.1	20.11	20.12	20.12	20.12	20.11	20.11	20.1	20.1	(88)

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

(89)m=	0.99	0.97	0.92	0.8	0.61	0.42	0.28	0.31	0.55	0.86	0.97	0.99	(89)

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

(90)m=	19.04	19.29	19.62	19.94	20.07	20.11	20.12	20.12	20.1	19.91	19.42	18.99	(90)

fLA = Living area ÷ (4) = 0.36 (91)

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

(92)m=	19.45	19.67	19.97	20.26	20.39	20.43	20.43	20.43	20.41	20.23	19.79	19.41	(92)

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

(93)m=	19.3	19.52	19.82	20.11	20.24	20.28	20.28	20.28	20.26	20.08	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=	0.98	0.96	0.92	0.8	0.62	0.43	0.29	0.33	0.56	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	746.16	846.1	912.7	890.38	734.3	495.04	322.08	338.8	533.01	713.37	718.65	709.16	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1355.35	1317.7	1197.52	995.36	756.34	497.15	322.26	339.14	542.1	839.4	1116.02	1346.48	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	453.23	316.91	211.91	75.58	16.4	0	0	0	0	93.77	286.11	474.17	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1928.09 (98)

Space heating requirement in kWh/m²/year 21.17 (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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	453.23	316.91	211.91	75.58	16.4	0	0	0	0	93.77	286.11	474.17	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	499.15	349.02	233.38	83.24	18.06	0	0	0	0	103.27	315.1	522.22	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2123.45 (211)

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

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

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

Water heating

Output from water heater (calculated above)

209.04	184.29	193.04	171.22	165.77	146	139.88	155.93	157.66	179.52	190.3	204.05

Efficiency of water heater 81.5 (216)

(217)m=	87.64	87.14	86.12	84.14	82.26	81.5	81.5	81.5	81.5	84.47	86.84	87.79	(217)

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

(219)m=	238.51	211.48	224.17	203.5	201.52	179.14	171.63	191.33	193.44	212.53	219.13	232.44

Total = Sum(219a)$_{1...12}$ = 2478.84 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2123.45	
Water heating fuel used			2478.84	
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			387.79	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	73.9	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	86.26	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	51.15	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			255.77	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.79	(257)

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SAP rating (Section 12)				88.99	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	458.66	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	535.43	(264)
Space and water heating	(261) + (262) + (263) + (264) =			994.09	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	201.26	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		898.12	(272)
CO2 emissions per m²		(272) ÷ (4) =		9.86	(273)
EI rating (section 14)				91	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2590.61	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	3024.18	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5614.79	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1190.51	(268)
Energy saving/generation technologies Item 1		3.07	=	-1988.48	(269)
'Total Primary Energy		sum of (265)…(271) =		5047.07	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		55.41	(273)

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User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 8

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	80	(1a) x	2.7	(2a) =	216	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	80	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	216	(5)

2. Ventilation rate:

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

Air changes per hour

			Value	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (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			4	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.34	(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) =		0.29	(21)

Infiltration rate modified for monthly wind speed

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

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

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

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.31	x1/[1/(1.1)+ 0.04]	=	1.38			(27)
Windows Type 2			0.86	x1/[1/(1.1)+ 0.04]	=	0.91			(27)
Windows Type 3			2.19	x1/[1/(1.1)+ 0.04]	=	2.31			(27)
Windows Type 4			1.76	x1/[1/(1.1)+ 0.04]	=	1.85			(27)
Windows Type 5			3.52	x1/[1/(1.1)+ 0.04]	=	3.71			(27)
Windows Type 6			3.41	x1/[1/(1.1)+ 0.04]	=	3.59			(27)
Windows Type 7			1.32	x1/[1/(1.1)+ 0.04]	=	1.39			(27)
Windows Type 8			0.97	x1/[1/(1.1)+ 0.04]	=	1.02			(27)
Windows Type 9			0.97	x1/[1/(1.1)+ 0.04]	=	1.02			(27)
Floor			0.566	x 0.09	=	0.05094			(28)
Walls Type1	24.17	10.01	14.16	x 0.13	=	1.84			(29)
Walls Type2	34.67	0.97	33.7	x 0.13	=	4.38			(29)
Walls Type3	24.17	4.36	19.81	x 0.13	=	2.57			(29)
Walls Type4	16.46	0	16.46	x 0.12	=	1.93			(29)
Walls Type5	0.99	0.97	0.02	x 0.13	=	0			(29)
Roof Type1	80.1	0	80.1	x 0.1	=	8.01			(30)
Roof Type2	0.57	0	0.57	x 0.1	=	0.06			(30)
Total area of elements, m²			181.68						(31)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 36.03 (33)

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Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16754.66	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		8.73	(36)

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

Total fabric heat loss	(33) + (36) =	44.76	(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=	40.45	40.26	40.08	39.22	39.06	38.31	38.31	38.17	38.6	39.06	39.38	39.72	(38)

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

(39)m=	85.21	85.02	84.84	83.98	83.82	83.07	83.07	82.93	83.36	83.82	84.15	84.49	

Average = Sum(39)$_{1…12}$ /12= 83.98 (39)

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

(40)m=	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04	1.05	1.05	1.06	

Average = Sum(40)$_{1…12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.46 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 92.69 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	

Total = Sum(44)$_{1…12}$ = 1112.32 (44)

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

(45)m=	151.21	132.25	136.47	118.97	114.16	98.51	91.28	104.75	106	123.53	134.85	146.44	

Total = Sum(45)$_{1…12}$ = 1458.42 (45)

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

(46)m=	22.68	19.84	20.47	17.85	17.12	14.78	13.69	15.71	15.9	18.53	20.23	21.97	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day):		0	(48)
Temperature factor from Table 2b		0	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0	(50)

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

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Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)
If community heating see section 4.3			
Volume factor from Table 2a		0	(52)
Temperature factor from Table 2b		0	(53)
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

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

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

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

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

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

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

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

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

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

(61)m=	50.96	45.22	48.18	44.8	44.4	41.14	42.51	44.4	44.8	48.18	48.45	50.96	(61)

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

(62)m=	202.17	177.47	184.65	163.77	158.56	139.65	133.8	149.15	150.8	171.71	183.3	197.39	(62)

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

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

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

Output from water heater

(64)m=	202.17	177.47	184.65	163.77	158.56	139.65	133.8	149.15	150.8	171.71	183.3	197.39	

Output from water heater (annual)$_{1…12}$ — 2012.43 (64)

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

(65)m=	63.02	55.28	57.42	50.76	49.06	43.04	40.98	45.93	46.44	53.12	56.95	61.43	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	48.91	43.44	35.33	26.75	19.99	16.88	18.24	23.71	31.82	40.4	47.15	50.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	327.52	330.92	322.36	304.12	281.11	259.48	245.03	241.63	250.19	268.42	291.44	313.07	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	(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=	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m=	84.7	82.26	77.18	70.5	65.94	59.78	55.08	61.73	64.51	71.4	79.1	82.57	(72)

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

(73)m=	565.63	561.12	539.36	505.86	471.54	440.63	422.84	431.56	451.01	484.72	522.19	550.4	(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	1	x	0.97	x	10.63	x	0.76	x	0.7	=	4.94	(74)
North	0.9x	1	x	0.97	x	20.32	x	0.76	x	0.7	=	9.44	(74)
North	0.9x	1	x	0.97	x	34.53	x	0.76	x	0.7	=	16.04	(74)
North	0.9x	1	x	0.97	x	55.46	x	0.76	x	0.7	=	25.76	(74)
North	0.9x	1	x	0.97	x	74.72	x	0.76	x	0.7	=	34.7	(74)
North	0.9x	1	x	0.97	x	79.99	x	0.76	x	0.7	=	37.15	(74)
North	0.9x	1	x	0.97	x	74.68	x	0.76	x	0.7	=	34.68	(74)
North	0.9x	1	x	0.97	x	59.25	x	0.76	x	0.7	=	27.52	(74)
North	0.9x	1	x	0.97	x	41.52	x	0.76	x	0.7	=	19.28	(74)
North	0.9x	1	x	0.97	x	24.19	x	0.76	x	0.7	=	11.23	(74)
North	0.9x	1	x	0.97	x	13.12	x	0.76	x	0.7	=	6.09	(74)
North	0.9x	1	x	0.97	x	8.86	x	0.76	x	0.7	=	4.12	(74)
East	0.9x	1	x	1.31	x	19.64	x	0.76	x	0.7	=	12.32	(76)
East	0.9x	1	x	0.86	x	19.64	x	0.76	x	0.7	=	8.09	(76)
East	0.9x	1	x	2.19	x	19.64	x	0.76	x	0.7	=	20.59	(76)
East	0.9x	1	x	1.31	x	38.42	x	0.76	x	0.7	=	24.1	(76)
East	0.9x	1	x	0.86	x	38.42	x	0.76	x	0.7	=	15.82	(76)
East	0.9x	1	x	2.19	x	38.42	x	0.76	x	0.7	=	40.29	(76)
East	0.9x	1	x	1.31	x	63.27	x	0.76	x	0.7	=	39.69	(76)
East	0.9x	1	x	0.86	x	63.27	x	0.76	x	0.7	=	26.05	(76)
East	0.9x	1	x	2.19	x	63.27	x	0.76	x	0.7	=	66.35	(76)
East	0.9x	1	x	1.31	x	92.28	x	0.76	x	0.7	=	57.88	(76)
East	0.9x	1	x	0.86	x	92.28	x	0.76	x	0.7	=	38	(76)
East	0.9x	1	x	2.19	x	92.28	x	0.76	x	0.7	=	96.76	(76)
East	0.9x	1	x	1.31	x	113.09	x	0.76	x	0.7	=	70.93	(76)
East	0.9x	1	x	0.86	x	113.09	x	0.76	x	0.7	=	46.57	(76)
East	0.9x	1	x	2.19	x	113.09	x	0.76	x	0.7	=	118.59	(76)
East	0.9x	1	x	1.31	x	115.77	x	0.76	x	0.7	=	72.61	(76)
East	0.9x	1	x	0.86	x	115.77	x	0.76	x	0.7	=	47.67	(76)
East	0.9x	1	x	2.19	x	115.77	x	0.76	x	0.7	=	121.39	(76)
East	0.9x	1	x	1.31	x	110.22	x	0.76	x	0.7	=	69.13	(76)
East	0.9x	1	x	0.86	x	110.22	x	0.76	x	0.7	=	45.38	(76)
East	0.9x	1	x	2.19	x	110.22	x	0.76	x	0.7	=	115.57	(76)
East	0.9x	1	x	1.31	x	94.68	x	0.76	x	0.7	=	59.38	(76)

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East	0.9x	1	x	0.86	x	94.68	x	0.76	x	0.7	=	38.98	(76)
East	0.9x	1	x	2.19	x	94.68	x	0.76	x	0.7	=	99.27	(76)
East	0.9x	1	x	1.31	x	73.59	x	0.76	x	0.7	=	46.16	(76)
East	0.9x	1	x	0.86	x	73.59	x	0.76	x	0.7	=	30.3	(76)
East	0.9x	1	x	2.19	x	73.59	x	0.76	x	0.7	=	77.16	(76)
East	0.9x	1	x	1.31	x	45.59	x	0.76	x	0.7	=	28.59	(76)
East	0.9x	1	x	0.86	x	45.59	x	0.76	x	0.7	=	18.77	(76)
East	0.9x	1	x	2.19	x	45.59	x	0.76	x	0.7	=	47.8	(76)
East	0.9x	1	x	1.31	x	24.49	x	0.76	x	0.7	=	15.36	(76)
East	0.9x	1	x	0.86	x	24.49	x	0.76	x	0.7	=	10.08	(76)
East	0.9x	1	x	2.19	x	24.49	x	0.76	x	0.7	=	25.68	(76)
East	0.9x	1	x	1.31	x	16.15	x	0.76	x	0.7	=	10.13	(76)
East	0.9x	1	x	0.86	x	16.15	x	0.76	x	0.7	=	6.65	(76)
East	0.9x	1	x	2.19	x	16.15	x	0.76	x	0.7	=	16.94	(76)
South	0.9x	1	x	0.97	x	46.75	x	0.76	x	0.7	=	21.71	(78)
South	0.9x	1	x	0.97	x	76.57	x	0.76	x	0.7	=	35.56	(78)
South	0.9x	1	x	0.97	x	97.53	x	0.76	x	0.7	=	45.3	(78)
South	0.9x	1	x	0.97	x	110.23	x	0.76	x	0.7	=	51.2	(78)
South	0.9x	1	x	0.97	x	114.87	x	0.76	x	0.7	=	53.35	(78)
South	0.9x	1	x	0.97	x	110.55	x	0.76	x	0.7	=	51.34	(78)
South	0.9x	1	x	0.97	x	108.01	x	0.76	x	0.7	=	50.16	(78)
South	0.9x	1	x	0.97	x	104.89	x	0.76	x	0.7	=	48.72	(78)
South	0.9x	1	x	0.97	x	101.89	x	0.76	x	0.7	=	47.32	(78)
South	0.9x	1	x	0.97	x	82.59	x	0.76	x	0.7	=	38.36	(78)
South	0.9x	1	x	0.97	x	55.42	x	0.76	x	0.7	=	25.74	(78)
South	0.9x	1	x	0.97	x	40.4	x	0.76	x	0.7	=	18.76	(78)
West	0.9x	1	x	1.76	x	19.64	x	0.76	x	0.7	=	16.55	(80)
West	0.9x	1	x	3.52	x	19.64	x	0.76	x	0.7	=	33.1	(80)
West	0.9x	1	x	3.41	x	19.64	x	0.76	x	0.7	=	32.07	(80)
West	0.9x	1	x	1.32	x	19.64	x	0.76	x	0.7	=	12.41	(80)
West	0.9x	1	x	1.76	x	38.42	x	0.76	x	0.7	=	32.38	(80)
West	0.9x	1	x	3.52	x	38.42	x	0.76	x	0.7	=	64.75	(80)
West	0.9x	1	x	3.41	x	38.42	x	0.76	x	0.7	=	62.73	(80)
West	0.9x	1	x	1.32	x	38.42	x	0.76	x	0.7	=	24.28	(80)
West	0.9x	1	x	1.76	x	63.27	x	0.76	x	0.7	=	53.32	(80)
West	0.9x	1	x	3.52	x	63.27	x	0.76	x	0.7	=	106.64	(80)
West	0.9x	1	x	3.41	x	63.27	x	0.76	x	0.7	=	103.31	(80)
West	0.9x	1	x	1.32	x	63.27	x	0.76	x	0.7	=	39.99	(80)
West	0.9x	1	x	1.76	x	92.28	x	0.76	x	0.7	=	77.76	(80)
West	0.9x	1	x	3.52	x	92.28	x	0.76	x	0.7	=	155.53	(80)
West	0.9x	1	x	3.41	x	92.28	x	0.76	x	0.7	=	150.67	(80)

West	0.9x	1	x	1.32	x	92.28	x	0.76	x	0.7	=	58.32	(80)
West	0.9x	1	x	1.76	x	113.09	x	0.76	x	0.7	=	95.3	(80)
West	0.9x	1	x	3.52	x	113.09	x	0.76	x	0.7	=	190.6	(80)
West	0.9x	1	x	3.41	x	113.09	x	0.76	x	0.7	=	184.65	(80)
West	0.9x	1	x	1.32	x	113.09	x	0.76	x	0.7	=	71.48	(80)
West	0.9x	1	x	1.76	x	115.77	x	0.76	x	0.7	=	97.56	(80)
West	0.9x	1	x	3.52	x	115.77	x	0.76	x	0.7	=	195.12	(80)
West	0.9x	1	x	3.41	x	115.77	x	0.76	x	0.7	=	189.02	(80)
West	0.9x	1	x	1.32	x	115.77	x	0.76	x	0.7	=	73.17	(80)
West	0.9x	1	x	1.76	x	110.22	x	0.76	x	0.7	=	92.88	(80)
West	0.9x	1	x	3.52	x	110.22	x	0.76	x	0.7	=	185.76	(80)
West	0.9x	1	x	3.41	x	110.22	x	0.76	x	0.7	=	179.95	(80)
West	0.9x	1	x	1.32	x	110.22	x	0.76	x	0.7	=	69.66	(80)
West	0.9x	1	x	1.76	x	94.68	x	0.76	x	0.7	=	79.78	(80)
West	0.9x	1	x	3.52	x	94.68	x	0.76	x	0.7	=	159.56	(80)
West	0.9x	1	x	3.41	x	94.68	x	0.76	x	0.7	=	154.58	(80)
West	0.9x	1	x	1.32	x	94.68	x	0.76	x	0.7	=	59.84	(80)
West	0.9x	1	x	1.76	x	73.59	x	0.76	x	0.7	=	62.01	(80)
West	0.9x	1	x	3.52	x	73.59	x	0.76	x	0.7	=	124.03	(80)
West	0.9x	1	x	3.41	x	73.59	x	0.76	x	0.7	=	120.15	(80)
West	0.9x	1	x	1.32	x	73.59	x	0.76	x	0.7	=	46.51	(80)
West	0.9x	1	x	1.76	x	45.59	x	0.76	x	0.7	=	38.42	(80)
West	0.9x	1	x	3.52	x	45.59	x	0.76	x	0.7	=	76.83	(80)
West	0.9x	1	x	3.41	x	45.59	x	0.76	x	0.7	=	74.43	(80)
West	0.9x	1	x	1.32	x	45.59	x	0.76	x	0.7	=	28.81	(80)
West	0.9x	1	x	1.76	x	24.49	x	0.76	x	0.7	=	20.64	(80)
West	0.9x	1	x	3.52	x	24.49	x	0.76	x	0.7	=	41.27	(80)
West	0.9x	1	x	3.41	x	24.49	x	0.76	x	0.7	=	39.98	(80)
West	0.9x	1	x	1.32	x	24.49	x	0.76	x	0.7	=	15.48	(80)
West	0.9x	1	x	1.76	x	16.15	x	0.76	x	0.7	=	13.61	(80)
West	0.9x	1	x	3.52	x	16.15	x	0.76	x	0.7	=	27.22	(80)
West	0.9x	1	x	3.41	x	16.15	x	0.76	x	0.7	=	26.37	(80)
West	0.9x	1	x	1.32	x	16.15	x	0.76	x	0.7	=	10.21	(80)

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

(83)m=	161.78	309.35	496.68	711.88	866.17	885.03	843.19	727.64	572.92	363.26	200.32	134.01	(83)

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

(84)m=	727.41	870.46	1036.04	1217.74	1337.71	1325.66	1266.03	1159.2	1023.94	847.98	722.51	684.41	(84)

7. Mean internal temperature (heating season)

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

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

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

(86)m=	0.99	0.97	0.91	0.76	0.57	0.4	0.29	0.33	0.55	0.86	0.97	0.99	(86)

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

(87)m=	20.16	20.37	20.65	20.89	20.98	21	21	21	20.99	20.83	20.44	20.11	(87)

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

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

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

(89)m=	0.98	0.96	0.88	0.72	0.52	0.34	0.23	0.26	0.48	0.81	0.96	0.99	(89)

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

(90)m=	18.94	19.24	19.62	19.93	20.03	20.05	20.05	20.05	20.04	19.87	19.35	18.88	(90)

fLA = Living area ÷ (4) = 0.4 (91)

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

(92)m=	19.42	19.69	20.03	20.31	20.4	20.43	20.43	20.43	20.42	20.25	19.78	19.37	(92)

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

(93)m=	19.27	19.54	19.88	20.16	20.25	20.28	20.28	20.28	20.27	20.1	19.63	19.22	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.95	0.88	0.72	0.53	0.35	0.24	0.28	0.5	0.82	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	711.45	827.48	910.49	878.69	705.51	470.49	305.47	321.49	507.93	692.25	690.13	672.83	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1275.81	1244.6	1135.44	945.78	717.06	471.57	305.57	321.7	514.02	796.07	1054.58	1268.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	419.88	280.3	167.36	48.3	8.59	0	0	0	0	77.24	262.4	443.48	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1707.56 (98)

Space heating requirement in kWh/m²/year 21.34 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	419.88	280.3	167.36	48.3	8.59	0	0	0	0	77.24	262.4	443.48	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	462.42	308.7	184.32	53.2	9.47	0	0	0	0	85.07	288.99	488.41	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 1880.57 (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)

202.17	177.47	184.65	163.77	158.56	139.65	133.8	149.15	150.8	171.71	183.3	197.39

Efficiency of water heater 81.5 (216)

(217)m=	87.55	86.95	85.67	83.45	81.93	81.5	81.5	81.5	81.5	84.17	86.73	87.72	(217)

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

(219)m=	230.91	204.1	215.53	196.26	193.53	171.35	164.17	183.01	185.03	204	211.35	225.04

Total = Sum(219a)$_{1...12}$ = 2384.26 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1880.57	
Water heating fuel used			2384.26	
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			345.49	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	65.44	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	82.97	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	45.57	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-85.43	(252)

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

Total energy cost (245)...(247) + (250)…(254) = 238.45 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.8	(257)

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SAP rating (Section 12)				88.82	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	406.2	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	515	(264)
Space and water heating	(261) + (262) + (263) + (264) =			921.2	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	179.31	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		803.28	(272)
CO2 emissions per m²		(272) ÷ (4) =		10.04	(273)
EI rating (section 14)				91	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2294.3	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2908.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5203.09	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	1060.67	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1988.48	(269)
‘Total Primary Energy		sum of (265)…(271) =		4505.52	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		56.32	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Anthony Wing-King	**Stroma Number:**	STRO002972
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 9

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.8	(1a) x	2.4	(2a) =	169.92	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	169.92	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18	(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		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

Infiltration rate modified for monthly wind speed

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

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

0.41	0.4	0.39	0.35	0.34	0.3	0.3	0.3	0.32	0.34	0.36	0.38

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			1.31	x1/[1/(1.1)+ 0.04]		=	1.38			(27)
Windows Type 2			1.31	x1/[1/(1.1)+ 0.04]		=	1.38			(27)
Windows Type 3			1.31	x1/[1/(1.1)+ 0.04]		=	1.38			(27)
Windows Type 4			1.49	x1/[1/(1.1)+ 0.04]		=	1.57			(27)
Windows Type 5			1.49	x1/[1/(1.1)+ 0.04]		=	1.57			(27)
Windows Type 6			1.31	x1/[1/(1.1)+ 0.04]		=	1.38			(27)
Windows Type 7			3.52	x1/[1/(1.1)+ 0.04]		=	3.71			(27)
Walls Type1	14.85	4.83	10.02	x	0.13	=	1.3			(29)
Walls Type2	32.4	2.98	29.42	x	0.13	=	3.82			(29)
Walls Type3	22.14	3.93	18.21	x	0.13	=	2.37			(29)
Walls Type4	22.41	0	22.41	x	0.12	=	2.63			(29)
Walls Type5	0.99	0	0.99	x	0.13	=	0.13			(29)
Total area of elements, m²			92.79							(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	22.63	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15399.12	(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	6.38	(36)

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

Total fabric heat loss (33) + (36) = 29.01 (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=	32.71	32.52	32.35	31.51	31.36	30.63	30.63	30.49	30.91	31.36	31.67	32	(38)

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

(39)m=	61.71	61.53	61.35	60.52	60.36	59.64	59.64	59.5	59.92	60.36	60.68	61.01	

Average = Sum(39)$_{1…12}$ /12= 60.52 (39)

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

(40)m=	0.87	0.87	0.87	0.85	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.86

Average = Sum(40)$_{1…12}$ /12= 0.85 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.27 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88 (43)

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

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

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

(44)m=	96.8	93.28	89.76	86.24	82.72	79.2	79.2	82.72	86.24	89.76	93.28	96.8

Total = Sum(44)$_{1…12}$ = 1056.04 (44)

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

(45)m=	143.56	125.56	129.56	112.96	108.38	93.53	86.67	99.45	100.64	117.28	128.02	139.03

Total = Sum(45)$_{1…12}$ = 1384.63 (45)

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

(46)m=	21.53	18.83	19.43	16.94	16.26	14.03	13	14.92	15.1	17.59	19.2	20.85	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	49.33	42.94	45.74	42.53	42.15	39.06	40.36	42.15	42.53	45.74	46	49.33	(61)

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

(62)m=	192.89	168.49	175.3	155.49	150.54	132.59	127.03	141.61	143.17	163.03	174.03	188.36	(62)

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

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

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

Output from water heater

(64)m=	192.89	168.49	175.3	155.49	150.54	132.59	127.03	141.61	143.17	163.03	174.03	188.36

Output from water heater (annual)$_{1...12}$ | 1912.5 | (64)

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

(65)m=	60.07	52.48	54.51	48.19	46.58	40.86	38.91	43.61	44.09	50.43	54.07	58.56	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	135.92	(66)

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

(67)m=	44.71	39.71	32.29	24.45	18.27	15.43	16.67	21.67	29.08	36.93	43.1	45.95	(67)

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

(68)m=	297.25	300.33	292.56	276.01	255.12	235.49	222.38	219.29	227.07	243.61	264.5	284.13	(68)

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

(69)m=	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	50.86	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	-90.62	(71)

Water heating gains (Table 5)

(72)m=	80.73	78.1	73.27	66.93	62.6	56.75	52.29	58.61	61.24	67.79	75.1	78.71	(72)

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

(73)m=	521.85	517.3	497.29	466.56	435.17	406.84	390.51	398.74	416.56	447.49	481.86	507.96	(73)

6. Solar gains:

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

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Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
East	0.9x 1	x	1.31	x	19.64	x	0.76	x	0.7	=	12.32	(76)
East	0.9x 1	x	1.31	x	19.64	x	0.76	x	0.7	=	12.32	(76)
East	0.9x 1	x	1.31	x	19.64	x	0.76	x	0.7	=	12.32	(76)
East	0.9x 1	x	1.31	x	38.42	x	0.76	x	0.7	=	24.1	(76)
East	0.9x 1	x	1.31	x	38.42	x	0.76	x	0.7	=	24.1	(76)
East	0.9x 1	x	1.31	x	38.42	x	0.76	x	0.7	=	24.1	(76)
East	0.9x 1	x	1.31	x	63.27	x	0.76	x	0.7	=	39.69	(76)
East	0.9x 1	x	1.31	x	63.27	x	0.76	x	0.7	=	39.69	(76)
East	0.9x 1	x	1.31	x	63.27	x	0.76	x	0.7	=	39.69	(76)
East	0.9x 1	x	1.31	x	92.28	x	0.76	x	0.7	=	57.88	(76)
East	0.9x 1	x	1.31	x	92.28	x	0.76	x	0.7	=	57.88	(76)
East	0.9x 1	x	1.31	x	92.28	x	0.76	x	0.7	=	57.88	(76)
East	0.9x 1	x	1.31	x	113.09	x	0.76	x	0.7	=	70.93	(76)
East	0.9x 1	x	1.31	x	113.09	x	0.76	x	0.7	=	70.93	(76)
East	0.9x 1	x	1.31	x	113.09	x	0.76	x	0.7	=	70.93	(76)
East	0.9x 1	x	1.31	x	115.77	x	0.76	x	0.7	=	72.61	(76)
East	0.9x 1	x	1.31	x	115.77	x	0.76	x	0.7	=	72.61	(76)
East	0.9x 1	x	1.31	x	115.77	x	0.76	x	0.7	=	72.61	(76)
East	0.9x 1	x	1.31	x	110.22	x	0.76	x	0.7	=	69.13	(76)
East	0.9x 1	x	1.31	x	110.22	x	0.76	x	0.7	=	69.13	(76)
East	0.9x 1	x	1.31	x	110.22	x	0.76	x	0.7	=	69.13	(76)
East	0.9x 1	x	1.31	x	94.68	x	0.76	x	0.7	=	59.38	(76)
East	0.9x 1	x	1.31	x	94.68	x	0.76	x	0.7	=	59.38	(76)
East	0.9x 1	x	1.31	x	94.68	x	0.76	x	0.7	=	59.38	(76)
East	0.9x 1	x	1.31	x	73.59	x	0.76	x	0.7	=	46.16	(76)
East	0.9x 1	x	1.31	x	73.59	x	0.76	x	0.7	=	46.16	(76)
East	0.9x 1	x	1.31	x	73.59	x	0.76	x	0.7	=	46.16	(76)
East	0.9x 1	x	1.31	x	45.59	x	0.76	x	0.7	=	28.59	(76)
East	0.9x 1	x	1.31	x	45.59	x	0.76	x	0.7	=	28.59	(76)
East	0.9x 1	x	1.31	x	45.59	x	0.76	x	0.7	=	28.59	(76)
East	0.9x 1	x	1.31	x	24.49	x	0.76	x	0.7	=	15.36	(76)
East	0.9x 1	x	1.31	x	24.49	x	0.76	x	0.7	=	15.36	(76)
East	0.9x 1	x	1.31	x	24.49	x	0.76	x	0.7	=	15.36	(76)
East	0.9x 1	x	1.31	x	16.15	x	0.76	x	0.7	=	10.13	(76)
East	0.9x 1	x	1.31	x	16.15	x	0.76	x	0.7	=	10.13	(76)
East	0.9x 1	x	1.31	x	16.15	x	0.76	x	0.7	=	10.13	(76)
South	0.9x 1	x	1.49	x	46.75	x	0.76	x	0.7	=	33.35	(78)
South	0.9x 1	x	1.49	x	46.75	x	0.76	x	0.7	=	33.35	(78)
South	0.9x 1	x	1.49	x	76.57	x	0.76	x	0.7	=	54.62	(78)

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South	0.9x	1	x	1.49	x	76.57	x	0.76	x	0.7	=	54.62	(78)
South	0.9x	1	x	1.49	x	97.53	x	0.76	x	0.7	=	69.58	(78)
South	0.9x	1	x	1.49	x	97.53	x	0.76	x	0.7	=	69.58	(78)
South	0.9x	1	x	1.49	x	110.23	x	0.76	x	0.7	=	78.64	(78)
South	0.9x	1	x	1.49	x	110.23	x	0.76	x	0.7	=	78.64	(78)
South	0.9x	1	x	1.49	x	114.87	x	0.76	x	0.7	=	81.95	(78)
South	0.9x	1	x	1.49	x	114.87	x	0.76	x	0.7	=	81.95	(78)
South	0.9x	1	x	1.49	x	110.55	x	0.76	x	0.7	=	78.87	(78)
South	0.9x	1	x	1.49	x	110.55	x	0.76	x	0.7	=	78.87	(78)
South	0.9x	1	x	1.49	x	108.01	x	0.76	x	0.7	=	77.06	(78)
South	0.9x	1	x	1.49	x	108.01	x	0.76	x	0.7	=	77.06	(78)
South	0.9x	1	x	1.49	x	104.89	x	0.76	x	0.7	=	74.83	(78)
South	0.9x	1	x	1.49	x	104.89	x	0.76	x	0.7	=	74.83	(78)
South	0.9x	1	x	1.49	x	101.89	x	0.76	x	0.7	=	72.69	(78)
South	0.9x	1	x	1.49	x	101.89	x	0.76	x	0.7	=	72.69	(78)
South	0.9x	1	x	1.49	x	82.59	x	0.76	x	0.7	=	58.92	(78)
South	0.9x	1	x	1.49	x	82.59	x	0.76	x	0.7	=	58.92	(78)
South	0.9x	1	x	1.49	x	55.42	x	0.76	x	0.7	=	39.54	(78)
South	0.9x	1	x	1.49	x	55.42	x	0.76	x	0.7	=	39.54	(78)
South	0.9x	1	x	1.49	x	40.4	x	0.76	x	0.7	=	28.82	(78)
South	0.9x	1	x	1.49	x	40.4	x	0.76	x	0.7	=	28.82	(78)
West	0.9x	1	x	1.31	x	19.64	x	0.76	x	0.7	=	12.32	(80)
West	0.9x	1	x	3.52	x	19.64	x	0.76	x	0.7	=	33.1	(80)
West	0.9x	1	x	1.31	x	38.42	x	0.76	x	0.7	=	24.1	(80)
West	0.9x	1	x	3.52	x	38.42	x	0.76	x	0.7	=	64.75	(80)
West	0.9x	1	x	1.31	x	63.27	x	0.76	x	0.7	=	39.69	(80)
West	0.9x	1	x	3.52	x	63.27	x	0.76	x	0.7	=	106.64	(80)
West	0.9x	1	x	1.31	x	92.28	x	0.76	x	0.7	=	57.88	(80)
West	0.9x	1	x	3.52	x	92.28	x	0.76	x	0.7	=	155.53	(80)
West	0.9x	1	x	1.31	x	113.09	x	0.76	x	0.7	=	70.93	(80)
West	0.9x	1	x	3.52	x	113.09	x	0.76	x	0.7	=	190.6	(80)
West	0.9x	1	x	1.31	x	115.77	x	0.76	x	0.7	=	72.61	(80)
West	0.9x	1	x	3.52	x	115.77	x	0.76	x	0.7	=	195.12	(80)
West	0.9x	1	x	1.31	x	110.22	x	0.76	x	0.7	=	69.13	(80)
West	0.9x	1	x	3.52	x	110.22	x	0.76	x	0.7	=	185.76	(80)
West	0.9x	1	x	1.31	x	94.68	x	0.76	x	0.7	=	59.38	(80)
West	0.9x	1	x	3.52	x	94.68	x	0.76	x	0.7	=	159.56	(80)
West	0.9x	1	x	1.31	x	73.59	x	0.76	x	0.7	=	46.16	(80)
West	0.9x	1	x	3.52	x	73.59	x	0.76	x	0.7	=	124.03	(80)
West	0.9x	1	x	1.31	x	45.59	x	0.76	x	0.7	=	28.59	(80)
West	0.9x	1	x	3.52	x	45.59	x	0.76	x	0.7	=	76.83	(80)

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West	0.9x	1	x	1.31	x	24.49	x	0.76	x	0.7	=	15.36	(80)
West	0.9x	1	x	3.52	x	24.49	x	0.76	x	0.7	=	41.27	(80)
West	0.9x	1	x	1.31	x	16.15	x	0.76	x	0.7	=	10.13	(80)
West	0.9x	1	x	3.52	x	16.15	x	0.76	x	0.7	=	27.22	(80)

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

(83)m=	149.08	270.4	404.55	544.33	638.24	643.31	616.4	546.76	454.03	309.05	181.78	125.38	(83)

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

(84)m=	670.94	787.7	901.84	1010.89	1073.41	1050.15	1006.91	945.5	870.59	756.54	663.65	633.34	(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=	0.98	0.94	0.86	0.7	0.52	0.36	0.26	0.29	0.47	0.77	0.94	0.98	(86)

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

(87)m=	20.47	20.65	20.84	20.96	20.99	21	21	21	21	20.94	20.7	20.44	(87)

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

(88)m=	20.19	20.19	20.2	20.21	20.21	20.22	20.22	20.22	20.21	20.21	20.2	20.2	(88)

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

(89)m=	0.97	0.93	0.83	0.66	0.48	0.32	0.21	0.24	0.42	0.73	0.93	0.98	(89)

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

(90)m=	19.52	19.76	20.01	20.17	20.2	20.22	20.22	20.22	20.21	20.15	19.84	19.47	(90)

fLA = Living area ÷ (4) = 0.38 (91)

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

(92)m=	19.88	20.1	20.32	20.47	20.5	20.51	20.51	20.51	20.51	20.45	20.16	19.83	(92)

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

(93)m=	19.73	19.95	20.17	20.32	20.35	20.36	20.36	20.36	20.36	20.3	20.01	19.68	(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=	0.96	0.92	0.83	0.66	0.48	0.33	0.22	0.25	0.43	0.73	0.93	0.97	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	647.36	726.82	749.15	670.75	519.7	343.55	224.45	235.89	374.14	555.55	614.09	616.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	952.18	926.03	838.97	691	522.33	343.71	224.46	235.91	375.06	585.47	783.6	944.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	226.79	133.87	66.83	14.58	1.95	0	0	0	0	22.26	122.04	244.46	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 832.79 (98)

Space heating requirement in kWh/m²/year 11.76 (99)

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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		90.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	226.79	133.87	66.83	14.58	1.95	0	0	0	0	22.26	122.04	244.46		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	249.77	147.44	73.6	16.05	2.15	0	0	0	0	24.52	134.41	269.23		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													917.17	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	192.89	168.49	175.3	155.49	150.54	132.59	127.03	141.61	143.17	163.03	174.03	188.36		
Efficiency of water heater													81.5	(216)
(217)m=	86.28	85.37	83.87	82.22	81.61	81.5	81.5	81.5	81.5	82.52	85.09	86.5		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	223.57	197.36	209.02	189.11	184.47	162.68	155.86	173.75	175.67	197.57	204.52	217.74		
Total = Sum(219a)$_{1...12}$ =													2291.31	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			917.17	
Water heating fuel used			2291.31	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			315.8	(232)
Electricity generated by PVs			-647.71	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	31.92	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)

Water heating cost (other fuel)	(219)	3.48	x 0.01 =	79.74	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	9.89	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	41.65	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

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

Total energy cost	(245)...(247) + (250)…(254) =	283.2	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.03	(257)
SAP rating (Section 12)		85.67	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	198.11	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	494.92	(264)
Space and water heating	(261) + (262) + (263) + (264) =			693.03	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	163.9	(268)
Energy saving/generation technologies Item 1		0.519	=	-336.16	(269)
Total CO2, kg/year		sum of (265)…(271) =		559.69	(272)
CO2 emissions per m²		(272) ÷ (4) =		7.91	(273)
EI rating (section 14)				94	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1118.95	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2795.4	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3914.34	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	230.25	(267)
Electricity for lighting	(232) x	0	=	969.52	(268)
Energy saving/generation technologies Item 1		3.07	=	-1988.48	(269)

'Total Primary Energy	sum of (265)…(271) =	3125.63	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =	44.15	(273)

SYNTEGRA CONSULTING

Date	02/11/2016
Reference	35 York Way
Author	Emma Jolly
Approver	Umer Uzair
Subject	Addendum to Energy Strategy Report (Ref: 14-1230)

In response to the above policy guidance the proposed development has been designed to incorporate the water efficiency measures in order to minimise the water consumption as 105 litres per person per day. This will be achieved by installing water efficient sanitary-ware fittings such as low flush WCs, spray showers, aerated taps and flow restrictors on the baths and showers. The table below provides the details of the proposed water efficient fittings and the calculations to verify that the target water savings of 105 litres/ person/ day can be achieved. The calculations below is in accordance with BRE Water calculator and also in accordance with Building Regulations Approved Document Part G.

Installation Type	Unit of Measure	Capacity/ flow rate (1)	Use factor (2)	Fixed use (litres/head/day) (3)	Total Consumption Litres/head/day [(1)x(2)]+(3)
WC (dual flush)	Full Flush Volume (litres)	**4.5**	1.46	0	**6.57**
	Part flush Volume (litres)	**3**	2.96	0	**8.88**
Taps (excluding kitchen/ utility room taps)	Flow rate (litres/minute)	**3**	1.58	1.58	**6.32**
Bath (where shower also present)	Capacity to overflow (litres)	**160**	0.11	0	**17.6**
Shower (where bath also present)	Flow rate (litres/minute)	**7**	4.37	0	**30.59**
Kitchen / utility room sink taps	Flow rate (litres/minute)	**5**	0.44	10.36	**12.56**
Washing machine	Litres/kg dry load	**8**	2.1	0	**16.8**
Dishwasher	Litres/place setting	**1.5**	3.6	0	**5.4**
				Total	**104.72 (Litres/head/day)**

The above table confirms that the development can meet the requirements as the total Water consumption will be less than 105 litres/ head/ day.