Sustainability Statement

139-141 Queens Crescent

For Suresh Patel

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About us:
XCO2 Energy are a low-carbon consultancy working in the built environment. We are a multi-disciplinary company consisting of engineers, environmental experts and architects, with specialists including CIBSE low carbon consultants, Code for Sustainable Homes, EcoHomes and BREEAM assessors and LEED accredited professionals.

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Executive Summary

This sustainability report outlines the sustainability strategy and summarises the energy performance and carbon dioxide emissions for the proposed development at 139-141 Queens Crescent, in line with the requirements set out by the London Plan and the London Borough of Camden.

The scheme will include the construction of 4 new dwellings (1 x 2 bed and 3 x 1 bed) as an extension onto the existing building.

This report is divided into two parts:

- Planning Policies & Sustainability Measures in response to Planning Policies; and
- Energy Hierarchy Summary

The Policy section provides an overview of the site and planning policies applicable to this development in accordance with the London Borough of Camden's planning policies and the London Plan. The Sustainability Measures section presents the sustainable design and construction principles adopted in the scheme and specifically gives responses to the GLA's Sustainable Design and Construction SPG and Camden sustainability guidance.

The second part of the report, The Energy Hierarchy Summary, then demonstrates how the London Plan and Camden energy policies have been met, giving a breakdown of the carbon emission reductions based on a Part L 2013 baseline building.

Policy and Sustainability Standards

In summary, the proposed development at 139-141 Queens Crescent exceeds the targets set out by Camden Council and the Greater London Authority (GLA). The development is expected to achieve the necessary sustainability requirements within the London Plan's Sustainable Design and Construction SPG and Camden Council's planning policies.

The development has considered and incorporated the following sustainability elements within the design:

Resource management

- Land
- Site layout and building design
- Energy and carbon dioxide emissions
- Renewable energy
- Water efficiency
- Materials and waste
- Nature conservation and biodiversity

Adapting to climate change and greening the city

- Tackling increased temperature and drought
- Increasing green cover and trees
- Flooding

Pollution management

- Land contamination
- Air pollution
- Noise
- Light pollution
- Water pollution

The London Plan's Energy Hierarchy

The methodology used to determine the CO_2 emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2A) outlined below:

1. Be Lean - use less energy
The first step addresses reduction in energy use, through the adoption of sustainable design and construction measures.

In accordance with this strategy, the proposed development will incorporate a range of energy efficiency measures including levels of insulation significantly exceeding current building regulations (2013) requirements, the installation of high performance glazing and energy efficient lighting. The implementation of these measures would potentially reduce regulated CO_2 emissions as far as is feasible given the restraints of the site (retained existing roof to form the floor of the first floor flats).

2. Be Clean - supply energy efficiently
The second strategy takes into account the efficient supply of energy, by prioritising decentralised energy generation.

The London Heat Map indicates that no existing district heating networks are situated within close proximity of the site. For the specific scale of development, CHP is not deemed a feasible option.

Energy efficient individual combi gas boilers are proposed for each residential unit for efficient energy supply for Space heating and Domestic Hot Water (DHW). Therefore, there is no further reduction of CO_2 emissions at the Be Clean stage of the energy hierarchy.

3. Be Green - use renewable energy
The third strategy covers the use of renewable technologies.

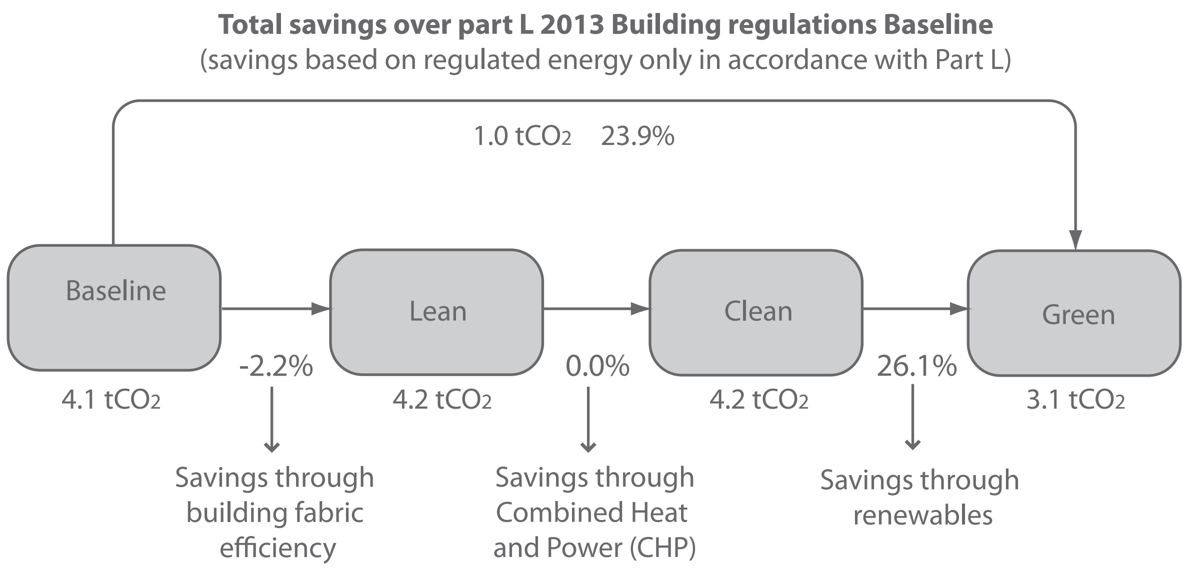
A feasibility study was carried out for the development and a range of renewable technologies were analysed. The analysis included a biomass heating system, ground-source heat pumps, air-source heat pumps, photovoltaic panels, solar thermal system, and wind turbines.

The analysis identified photovoltaic solar panels as the most suitable technology for this development. The installation of 18m^2 of PV panels with a rated output of 2.7 kWp will reduce the development's regulated CO_2 emissions by 26.1%.

In total, the development is expected to reduce regulated CO_2 emissions by 23.9% when compared with a notional building built to current Part L Building Regulations (2013), which is a significant saving for a development of this nature.

Conclusion

The diagram below provides a summary of the regulated CO_2 savings at each stage of the London Plan Energy Hierarchy. Overall, the development will achieve a regulated CO_2 saving of 23.9% beyond Part L 2013 baseline.

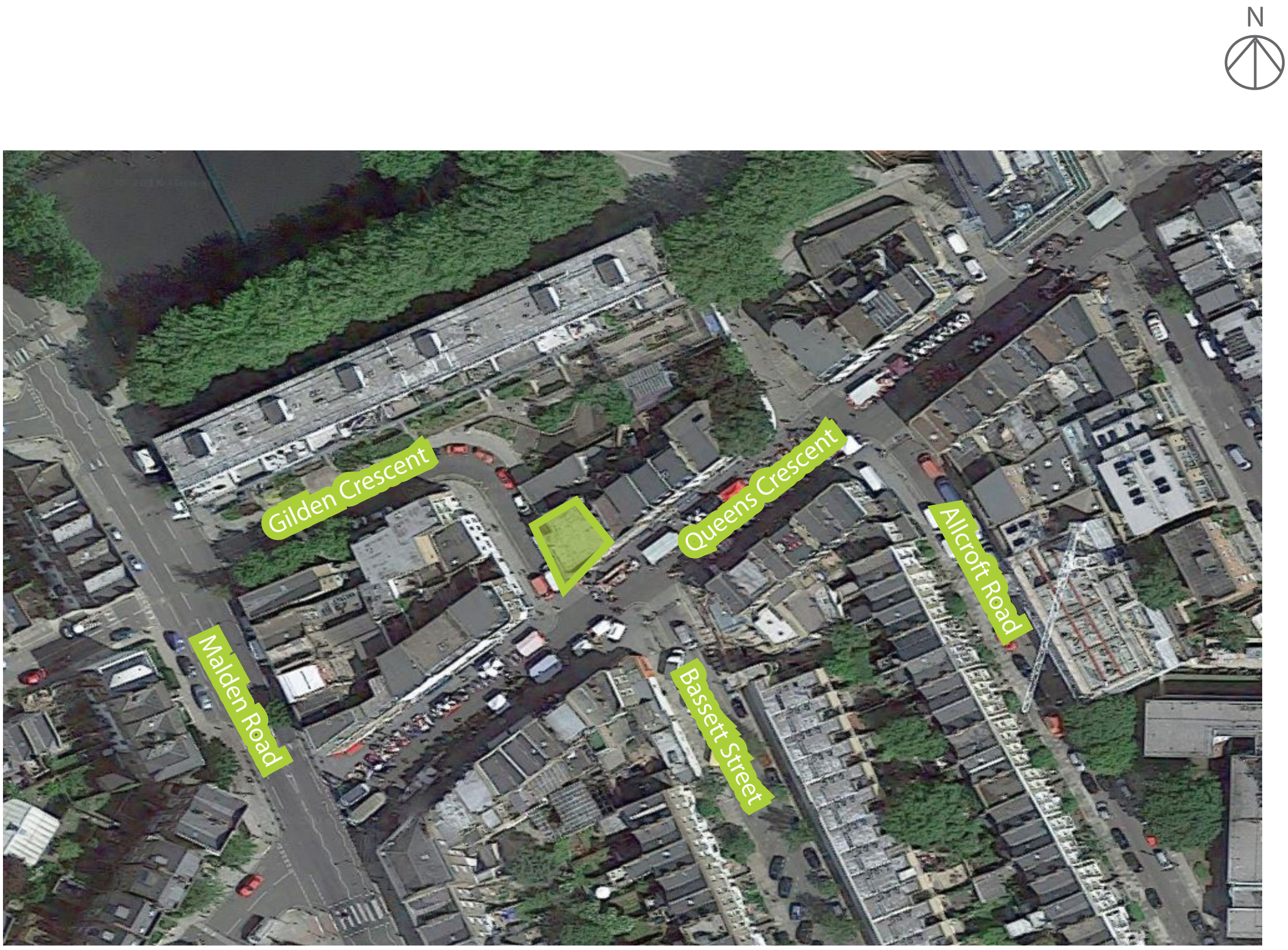

Total savings over part L 2013 Building regulations Baseline
(savings based on regulated energy only in accordance with Part L)
1.0 tCO2 23.9%
Baseline
Lean
Clean
Green
4.1 tCO2
-2.2%
4.2 tCO2
0.0%
4.2 tCO2
26.1%
3.1 tCO2
Savings through building fabric efficiency
Savings through Combined Heat and Power (CHP)
Savings through renewables

Site

The proposed site is located on the northern side of Queens Crescent, on the corner with Gilden Crescent within the London Borough of Camden, in between Primrose Hill and Hampstead Heath.

The proposed scheme comprises the construction of 4 new dwellings as an extension onto the existing building at 139-141 Queens Crescent. The existing building will not form part of this application.

The approximate site location and boundary is shown in the figure below.



Approximate site location of 139-141 Queens Crescent

Planning Policies

This report outlines the sustainability related strategies and policies for the proposed development at 139-141 Queens Crescent, as set out by the London Borough of Camden's planning documents as well as the London Plan, Further Alterations to the London Plan (March 2015) and Housing Standards Minor Alterations To The London Plan (March 2016), herein referred to as The London Plan.

Camden Core Strategy 2010

The Camden Core Strategy sets out the Council's key planning policies and is a central part of their Local Development Framework (LDF). The pertinent sustainability excerpts are inserted below:

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 developments to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) Ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) Promoting the efficient use of land and buildings;

c) Minimising carbon emissions from the redevelopment, 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 decentralised energy networks;*
3. *Generating renewable energy on-site; and*

d) Ensuring buildings and spaces are designed to cope with, and minimise 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.

Water and surface water flooding

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

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.

CS18 – Dealing with our waste and encouraging recycling

The Council will seek to make Camden a low waste borough. We will:

b) make sure that developments include facilities for the storage and collection of waste and recycling.

Camden Development Policies 2010

In addition to the Core Strategy Document the Camden Development Policies also forms part of the LDF. The policy relating to sustainability is listed below:

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 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.

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

d) encouraging the provision of attractive and efficient water features.

The Camden Local Plan (2016) is currently undergoing review and consultation before it is issued. The development at 139-141 Queens Crescent will aim to follow the Sustainability and climate change sections within the plan irrespective of the fact that it has not yet been formally issued.


Camden Development Policies 2010-2025
Local Development Framework
Camden

Camden Planning Guidance - Sustainability CPG3 - 2013

The Camden Planning Guidance support the policies set out in the Local Development Framework (LDF). While the Camden LDF contains policies relating to sustainability in their Core Strategy and Development Policies documents, the Council also has a separate planning guidance specific to sustainability.

The sections that will be covered by the following sections of this Sustainability Statement are listed below:

The energy hierarchy
All new developments are to be designed to minimise carbon dioxide emissions by being as energy efficient as is feasible and viable.

Energy efficiency: new buildings
All new developments are to be designed to minimise carbon dioxide emissions by being as energy efficient as is feasible and viable.

Decentralised energy networks and combined heat and power
Development should follow the Energy Hierarchy
1. use less energy
2. supply energy efficiently
3. use renewable energy

Renewable Energy
All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

Water Efficiency
The Council expects all developments to be designed to be water efficient by minimising water use and maximising the re-use of water. This includes new and existing buildings.

Sustainable use of materials
Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.

Sustainability assessment tools
Developments are anticipated to be able to achieve BREEAM 'Excellent' from 2013 onwards and at least 60% of Energy and Water credits and 40% of Materials credits.

Brown roofs, green roofs and green walls
The Council will expect all developments to incorporate brown roofs, green roofs and green walls unless it is demonstrated this is not possible or appropriate. This includes new and existing buildings. Special consideration will be given to historic buildings to ensure historic and architectural features are preserved.

Flooding
Developments must not increase the risk of flooding, and are required to put in place mitigation measures where there is known to be a risk of flooding.

Adapting to climate change
All development is expected to consider the impact of climate change and be designed to cope with the anticipated conditions.

The London Plan

The London Plan requires compliance with the following policies relating to climate change:

- Policy 5.2 Minimising Carbon Dioxide Emissions (refer to the supplementary Energy Report)
    - *Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:*
      1 Be lean: use less energy
      2 Be clean: supply energy efficiently
      3 Be green: use renewable energy
    - *The Mayor will work with boroughs and developers to ensure that major developments meet a 40% carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.*

The GLA update of the London Plan (April 2014) states that a 35 per cent carbon reduction target beyond Part L 2013 of the Building Regulations will be required for major developments - this is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010 of the Building Regulations, as set out in London Plan Policy 5.2 above. Compliance with the following relevant London Plan policies are addressed within sections found later in this report.

- Policy 5.2 Minimising Carbon Dioxide Emissions
- Policy 5.3 Sustainable Design and Construction
- Policy 5.5 Decentralised Energy Networks
- Policy 5.6 Decentralised Energy in Development proposals
- Policy 5.7 Renewable Energy where feasible.
- Policy 5.9 Overheating and Cooling
- Policy 5.11 Green Roofs and Development site Environs
- Policy 5.12 Flood Risk Management
- Policy 5.13 Sustainable Drainage
- Policy 5.15 Water use and Supplies
- Policy 5.18 Construction, Excavation and Demolition Waste

The proposed development at 139-141 Queens Crescent does not qualify as a major development, however, the design team have endeavoured to reduce CO_2 emissions on site through the use of energy efficient building fabric, construction and materials in line with the London Plan target.

Compliance with the aforementioned relevant London Plan policies is addressed within subsequent sections in this report.

GLA's Sustainable Design and Construction SPG (2014)

The Sustainable Design and Construction SPG (April 2014) provides additional information to support the implementation of the Mayor's London Plan. The SPG does not set new policy, but explains how policies in the London Plan should be carried through into action.

It is applicable to all major developments and building uses. It covers the following areas:

- Resource Management
- Adapting to Climate Change and Greening the City
- Pollution Management

This SPG provides a basis for sustainable design in London and is used as the overarching structure of this report. Where additional local policies are addressed by these areas this has also been indicated.


SUSTAINABLE DESIGN AND CONSTRUCTION
SUPPLEMENTARY PLANNING GUIDANCE
APRIL 2014
LONDON PLAN 2011
IMPLEMENTATION FRAMEWORK
MAYOR OF LONDON

Housing SPG (2016)

This Supplementary Planning Guidance (SPG) provides guidance on the implementation of housing policies in the London Plan and it replaces the 2012 Housing SPG.

Part 2 *Quality* includes standards relating -among others- to the environmental quality of new housing and is most relevant within the context of this report.

Energy Planning - GLA Guidance on preparing energy assessments (2016)

This document is an update to the previous version of the Energy Planning Guidance (2015) and is mainly aimed at:

- Clarifying energy targets and baselines in the context of Government announcements regarding zero carbon policy; and
- Clarifying the hierarchy in London Plan Policy 5.6 and situations where CHP is or is not considered appropriate for developments.

Housing Standards Review

The government announced the conclusion to the Housing Standards Review on 27 March 2015. The review aimed to simplify government regulations and standards into one key set, driven by Building Regulations.

As an outcome from the Deregulation Bill (2015) the written ministerial statement withdrew the Code for Sustainable Homes (in England) so Local Authorities will no longer require it as a planning condition for new approvals, nor will local authorities be able to enforce it. Where there are existing contractual arrangements, for example with Registered Social Landlords under the Affordable Funding Programme 2015-2018, it is possible to continue to register and certify against the Code.

One outcome from the review is dual level Building Regulations (Access and Water), which will give local authorities some choice to require developers to build to different standards than the minimum requirements. Furthermore, with appropriate evidence, local authorities can also use the new space standards which make up the new national technical standards. There will also be a new mandatory Building Regulation for security. The Building Regulations have come into play as of October 2015.

The new dual level Building Regulations have been introduced because of clauses within the Deregulation Act. The Act also brings in a Clause which amends the Planning and Energy Act 2008 to prevent local authorities from requiring higher levels of energy efficiency than building regulations. This second clause has yet to be commenced, and the written ministerial statement sets out how this will be implemented in 2016.

As a result in the changes in Government Policy, the proposed development at 139-141 Queens Crescent will not be assessed under the Code for Sustainable Homes. However, the dwellings have been designed in line with the Code for Sustainable Homes principles in mind to ensure wellbeing of occupants, and that impacts to the environment are minimised where possible.

Proposed Sustainable Design & Construction Measures

Introduction

This section presents the sustainability measures taken to address the three major issues identified within the London Plan's Sustainable Design and Construction SPG (April 2014).

The SPG is selected as the basis of this section as it better reflects the advances of the approach as to what constitutes sustainable development in Greater London, particularly in the absence of the Code. The design and construction issues relating to the principles of sustainable development, as identified within Camden's Planning Policy and prevalent throughout the London Plan, are also addressed.

1. Land

Ideally, a sustainable development utilises land that has been previously developed, thereby ensuring that 'green' spaces or areas of open public space are retained wherever possible. This is particularly important in urban centres where ideally 100% of a new development should utilise previously developed land and deliver improved density.

The site's building footprint is entirely on an existing building, therefore eliminating the need to build on new land.

The intention is to extend outwards and upwards by 1 storey to provide 4 new sustainable residential dwellings. The multiple benefits for the community will be complemented by the improvement of the quality of the built environment.

The proposal is therefore in agreement with the principles of sustainable development.

Applicable Policies:

London Plan - 1.1, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16, 2.17, 2.18, 3.3, 4.3, 6.1, 7.6

Camden Core Strategy: CS 13

2. Site Layout & Building Design

The building design seeks to maximise the potential use of natural systems, despite the constraints inherent in an urban context.

Access to daylight and sunlight in habitable spaces is considered optimum given the site constraints; the vast majority of living spaces (open plan living rooms and kitchens) are orientated to the south east or south west, and shall benefit from satisfactory levels of sunlight during the winter. The size of the openings follows good practice design and shall offer abundant daylight in all habitable spaces.

The effect of the development on the surrounding buildings has been minimised in terms of overshadowing effects.

Quality housing delivery is a key issue at national, regional and local levels, and the new scheme will deliver new, resource-efficient housing to the area.

The proposal will be designed in line with 'Secured by Design' principles, creating private and communal places that offer a sense of safety and are secure for future residents.

Further details on the design rationale and development in response to the specific setting and various needs of future occupants can be found in the accompanying Design and Access Statement.

Applicable Policies:

London Plan - 2.18, 4.3, 5.2, 5.3, 5.4, 5.6, 5.7, 5.9, 5.10, 5.11, 5.12, 5.13, 5.16, 5.18, 5.21, 6.1, 6.7, 6.9, 6.10, 6.11. 6.13, 7.1, 7.6, 7.14, 7.15, 7.18, 7.19, 7.21, 7.22

Camden Core Strategy: CS 13

3. Energy & Carbon Dioxide Emissions
An energy assessment (as part of this report) has been carried out for the development. The assessment was based on the Energy Hierarchy advocated in Policy 5.2 of the London Plan:

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use renewable energy

The assessment has indicated that there will be a regulated CO2 emissions saving of 23.9% for the proposed scheme once Lean, Clean and Green measures have been implemented.

At the 'Be Lean' stage, energy efficiency will be maximised through passive and active measures, including:

- Optimising daylight and maximising beneficial solar gain;
- Achieving an efficient building fabric with a high thermal mass, airtightness level and U-value below Building Regulation standards;
- Maximising the potential for natural ventilation;
- Energy efficient heating systems, Including low energy light fittings throughout the scheme.

There are no energy efficiency measures that will impact carbon dioxide emissions at the 'Be Clean' phase, due to the lack of viability of a CHP decentralised heating system for a development of this scale. Connection to an existing district heating network is not currently feasible due to a lack of networks in the vicinity of the development.

CO_2 emissions have been reduced further by the inclusion of photovoltaics, as oulined within the following sub-section.

Each flat will be sub-metered to give occupants the ability to constantly review the amount of energy they are using and make behavioural changes.

Applicable Policies:
London Plan - 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.17
Camden Core Strategy: CS 13
Camden Development Policies: DP 22
Camden Sustainability CPG3

4. Renewable Energy
The proposed development will incorporate the installation of 18m^2 of photovoltaic panels as a renewable energy source. The PV array will be placed horizontally to minimise visibility from street level.

Applicable Policies:
London Plan - 5.4, 5.7
Camden Core Strategy: CS 13
Camden Development Policies: DP 22
Camden Sustainability CPG3

5. Water Efficiency
Water efficiency is a key sustainability principle for the development, particularly in light of the risk to London's water supply associated with projected climate change. As such, the design team is seeking to achieve a reduction in water use for the building over typical domestic performance.

Water efficient sanitary fittings will be installed as standard; this includes WCs, wash hand basin taps, kitchen taps, showers, baths and any dishwashers, washing machines or washer/dryers.

The dwellings will aim to meet a water consumption target less than or equal to 105 litres/person/day, in line with Policy 5.15 of the London Plan (*Housing Standards Minor Alterations 2016*).

Applicable Policies:
London Plan - 5.3, 5.13, 5.15
Camden Core Strategy: CS 13
Camden Development Policies: DP 23
Camden Sustainability CPG3

6. Materials and Waste

The materials specification will be important in terms of balancing the requirements of the design brief with the requirements for a building with a low environmental impact.

The architectural specification of the building envelope will seek to maximise the use of pre-fabricated elements. More than five of the key elements of the building envelope will achieve a rating of A+ to C in the BRE's *The Green Guide*.

In addition, all of the timber used will be sourced from accredited Forest Stewardship Council (FSC) or a Programme for the Endorsement of Forestry Certification (PEFC) source. Non-timber materials will be responsibly sourced where possible.

Internal finishes and paints will aim to be specified with due regard to their potential impact on the indoor air quality; certified low-VOC and low-formaldehyde products shall be preferred.

Sufficient space has been allowed for the storage of recyclable materials and waste within the kitchens of each new flat. Food waste bins will also be provided for each unit. Dedicated external waste storage for the dwellings will be provided to meet the Camden Council requirements. Camden Council provides recyclable household waste collection and sorting.

Waste generated during construction will be minimised through the implementation of the waste hierarchy.

Applicable Policies:

London Plan - 5.3, 5.20, 7.6, 7.14; Standard 22 & 23 of Housing SPG
Camden Core Strategy: CS 18
Camden Sustainability CPG3

7. Nature Conservation & Biodiversity

The proposal site is entirely built/hardstanding and so there is no existing ecology. The roof is pitched and will incorporate photovoltaics so there is no scope to include a green roof or any other planting.

The proposed scheme will therefore be neutral in terms of the impact on existing and surrounding ecology.

Applicable Policies:

London Plan - 5.3, 7.19
Camden Core Strategy: CS 15

8. Tackling Increased Temperature and Drought
The potential risk of overheating will be mitigated by incorporating passive and active design measures.

a. *Minimising internal heat generation through energy efficient design:*
The dwellings will be served by individual heating systems therefore the heating distribution pipework will be held at a minimum. Heat sources and pipework will be sufficiently insulated to reduce heat dissipation in living spaces.

b. *Reducing the amount of heat entering the building in summer:*
Appropriately sized windows and shading from blinds and curtains will reduce solar gains into occupied spaces during the summer.

c. *Use of thermal mass and high ceilings to manage the heat within the building:*
During peak summer periods the thermal mass of the building will absorb and store excess heat. The building will release its heat in the cooler evenings to allowing for cooler internal spaces dampening the peak diurnal weather conditions.

d. *Passive ventilation:*
The building has allowed for passive ventilation as the main strategy for providing fresh air and dissipating heat. The strategy for reducing potential overheating includes single-sided ventilation, cross ventilation and night purge ventilation.

e. *Mechanical ventilation:*
Mechanical ventilation has not been included within the ventilation strategy. Instead the development fully utilises natural ventilation to minimise energy consumption.

Applicable Policies:
London Plan - 5.3, 5.9, 5.15, 7.6
Camden Core Strategy: CS 13
Camden Development Policies: DP 22

9. Increasing Green Cover and Trees
The site is currently hardstanding in its entirety, with no areas of green cover or trees.

It would not be feasible to increase green cover for the site as there are no external areas available for any planting to occur and the pitched roof will be utilised for photovoltaics.

Applicable Policies:
London Plan - 2.18, 5.3, 5.10, 5.11, 7.21
Camden Core Strategy: CS 15

10. Flood Risk
According to the Environment Agency's Flood Risk Map, the site lies within a zone with low risk of flooding from rivers and sea (Zone 1). The site is also shown as being at low risk of flooding within Camden Council's Flood Risk Management Strategy.

The proposed scheme will not increase flood risk to adjacent properties as the post-development surface water run-off volume will be the same as the pre-developed site.

Applicable Policies:
London Plan - 5.3, 5.12, 5.13
Camden Core Strategy: CS 13
Camden Development Policies: DP 23
Camden Sustainability CPG3

11. Air Pollution
Plant equipment (gas boilers) will be selected that meets the air quality standards within the SPG Appendix 7.

Applicable Policies:
London Plan - 3.2, 5.3, 7.14
Camden Core Strategy: CS 18
Camden Sustainability CPG3

Energy Hierarchy Summary

The methodology employed to determine the potential CO_2 savings for this development is in accordance with the three step Energy Hierarchy outlined in the London Plan:

- Be Lean - Improve the energy efficiency of the development
- Be Clean - Supply as much of the remaining energy requirement with low-carbon technologies such as combined heat and power (CHP)
- Be Green - Offset a proportion of the remaining carbon dioxide emissions using renewable technologies.

Energy calculations were carried out using the FSAP 2012 methodology for the residential units. This is in line with Building Regulations Part L 2013.

The data from the individual SAP calculations was combined in order to give site wide energy consumption and CO_2 emissions.

Demand Reduction (Be Lean)

Passive Design Measures

Enhanced Building Fabric

The heat loss of different building elements is dependent upon their U-value. The lower the U-value, the better the level of insulation of a particular element. A building with low U-values has a reduced heating demand during the cooler months.

The proposed development at 139-141 Queens Crescent will incorporate high levels of insulation and high-performance glazing on all of the facades to significantly reduce the demand for space heating (refer to the table below). The development's Part L U-value targets will be exceeded.

Residential U-Values (W/m²K)

Element	Building Regulations	Proposed	% Improvement
Walls	0.30	0.15	50%
Floor	0.25	0.2	20%
Roof	0.20	0.10	50%
Windows	2.0	1.3	35%

Air Tightness

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration into a building.

Current Part L Building Regulations (2013) sets a maximum air permeability rate of $10m^3/m^2$ at 50Pa. The development is likely to improve upon this to achieve at least $5m^3/m^2$ at 50Pa through the application of best practice construction techniques.

Orientation & Site Layout

Passive solar gain reduces the amount of energy required for space heating during the winter months. The building is designed to optimise passive solar gain by maximising glazing on the south-eastern and south-western facades where possible.

Lighting

The development has been designed to improve daylighting in all habitable spaces, as a way of improving the health and wellbeing of its occupants. All of the habitable rooms, such as living rooms, will benefit from good sized windows to increase the amount of daylight within the internal spaces.

Natural Ventilation

Natural ventilation will be used to provide fresh air to all residential units to minimise energy demand for ventilation. Extract fans will be provided in kitchens and bathrooms.

Overheating

The development has followed the London Plan Policy 5.9 cooling hierarchy and has been documented within the 'Proposed Sustainable Design & Construction Measures' section of this report.

Overheating risks shall be minimised by a combination of passive and active measures, including pipework insulation, internal shading devices, natural cross ventilation and thermal mass effects.

Active Design Measures

High Efficacy Lighting

The development intends to incorporate low energy lighting fittings throughout the development. 100% of all light fittings will be specified as low energy lighting, and will accommodate compact fluorescent (CFL's) luminaries and/or LEDs.

Internal areas which are not frequently used will be fitted with occupant sensors, whereas daylit areas will be fitted with daylight sensors.

Heating and Cooling Infrastructure (Be Clean)

Energy System Hierarchy

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy 5.6 states that energy systems should consider:

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

Local supply of heat and power minimises distribution losses, thereby achieving a greater efficiency and reducing CO_2 emissions, when compared to the individual systems.

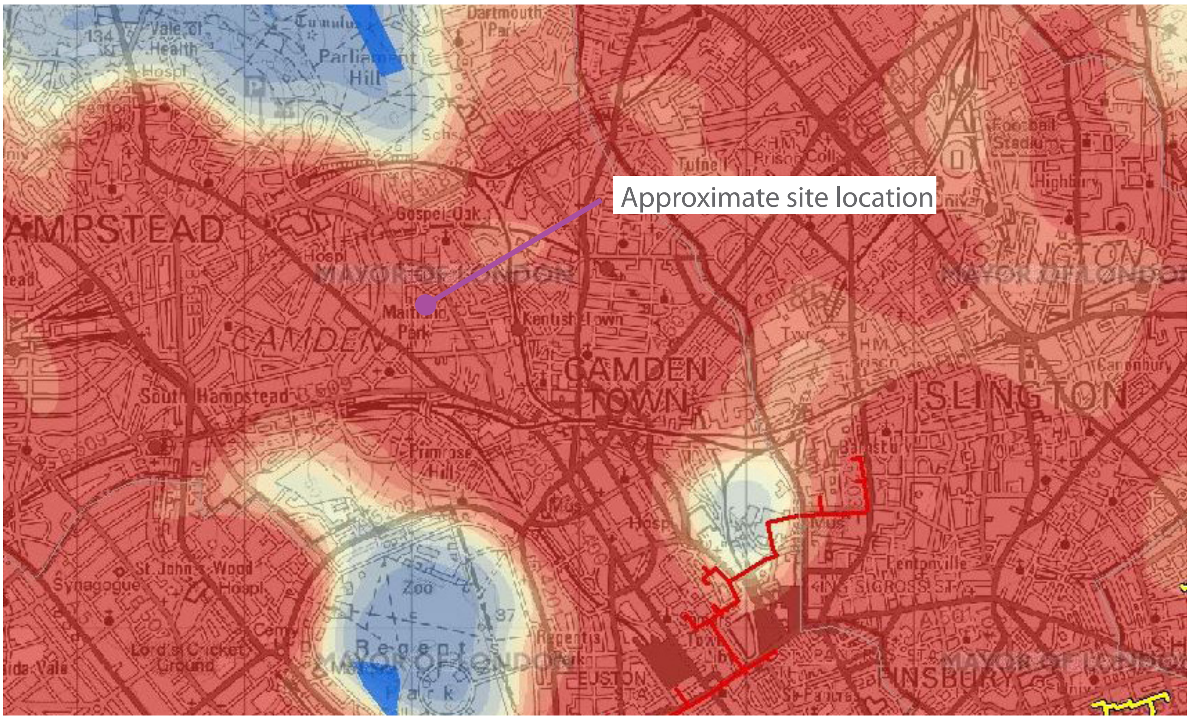
In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network to surrounding residencies and commercial units.

Connection to Existing Low Carbon Heat Distribution Networks

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map below shows the energy demand for different areas. Darker shades of red signify areas where energy demand is high. The map also highlights any existing and proposed district heating systems within the vicinity of the development, as well as the areas identified with the potential to deploy decentralised heating (DH) networks.

A review of the map and publicly available information shows that there are currently no existing or proposed district heat networks within close proximity to the proposed site. Space heating and domestic hot water will be supplied by individual gas boilers within each dwelling.



London Heat Map

Decentralised Energy Potential — Existing DH networks in the area — Proposed DH networks

Renewable Energy (Be Green)

Once the energy demand has been minimised, methods of generating low and zero carbon energy can be assessed. The renewable technologies to be considered for the development are:

- Biomass
- Photovoltaic panels
- Solar thermal panels
- Ground/water source heat pumps
- Air source heat pump
- Wind energy

The table below summarises the factors taken into account in determining the appropriate renewable technology for this project. This includes estimated lifetime, level of maintenance, and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible).

The feasibility study concludes that photovoltaic panels are the most feasible option for the site.

139-141 Queens Crescent

	Comments	Lifetime	Maintenance	Impact on External Appearance	Site Feasibility
Biomass 	Not adopted -burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20yrs	High	High	1
PV 	Adopted Technology	25yrs	Low	Med	8
Solar Thermal 	Not adopted -solar thermal array would require additional plumbing, space for hot water storage.	25yrs	Low	Med	3
GSHP 	Not adopted -the installation of ground loops require significant space, additional time at the beginning of the construction process and very high capital costs.	20yrs	Med	Low	1
ASHP 	Not adopted -ASHP evaporator units are located externally and produce noise which can be an issue in a residential location, especially at night.	20yrs	Med	Med	4
Wind 	Not adopted -wind turbines would achieve low CO_2 savings in this site due to space limitations. In addition, they would have a significant visual impact on the neighbourhood.	25yrs	Med	High	1

Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

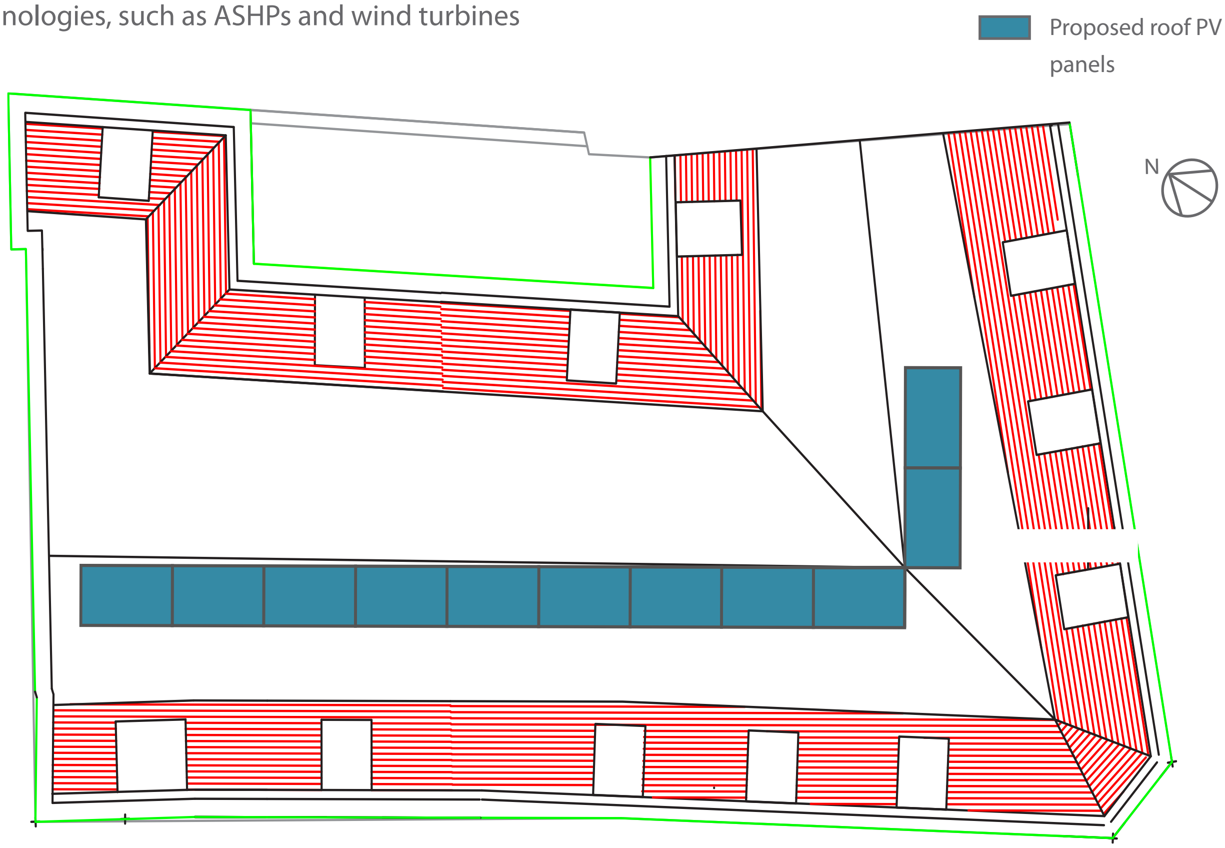
The feasibility study shows that photovoltaics are the most suitable renewable technology for this development for the following reasons:

- there is sufficient roof space to install enough PV modules to have a significant impact on carbon dioxide emissions
- the installation of photovoltaics is much simpler when compared to other renewable technologies
- photovoltaics sited on the roof areas are less visually instrusive when compared to other technologies, such as ASHPs and wind turbines

Further to the reasons stated above, it has been decided that mono-crystalline PV is the most suitable option for the development, as it would have the least internal space requirement.

The image below presents a proposed PV roof plan.

It is proposed to place the PV panels perpendicularly to the pitched roof to minimise the visual impacts of the installations. 18m^2 of 15% efficiency monocrystalline PV panels, rated at 2.7 kWp, would produce regulated CO_2 savings of 25.5% after the previous measures have been implemented, and 26.1% savings compared to the baseline emissions.



Indicative PV roof layout for the proposed development at 139-141 Queens Crescent

Conclusion

Policy and Sustainability Standards

In summary, the proposed development at 139-141 Queens Crescent exceeds the targets set out by Camden Council and the Greater London Authority (GLA). The development is expected to achieve the necessary sustainability requirements within the London Plan's Sustainable Design and Construction SPG and Camden Council's planning policies.

Energy Hierarchy

In line with the London Plan's three step energy hierarchy the regulated CO_2 emissions for this development have been reduced by 23.9%, once energy efficiency measures and renewable technologies have been taken into account.

The tables on the following page provides a breakdown of the CO_2 savings made at each stage of the Energy Hierarchy. The reductions made through each step have been outlined below:

1. Be Lean - use less energy

The first step addresses reduction in energy use, through the adoption of sustainable design and construction measures.

In accordance with this strategy, the proposed development will incorporate a range of energy efficiency measures including levels of insulation significantly exceeding current building regulations (2013) requirements, the installation of high performance glazing and energy efficient lighting. The implementation of these measures would potentially reduce regulated CO_2 emissions as far as is feasible given the restraints of the site (retained existing roof to form the floor of the first floor flats).

2. Be Clean - supply energy efficiently

The second strategy takes into account the efficient supply of energy, by prioritising decentralised energy generation.

The London Heat Map indicates that no existing district heating networks are situated within close proximity of the site. For the specific scale of development, CHP is not deemed a feasible option.

Energy efficient individual combi gas boilers with flue heat recovery are proposed for each residential unit for efficient energy supply for Space heating and Domestic Hot Water (DHW). Therefore there is no further reduction of CO_2 emissions at the Be Clean stage of the energy hierarchy.

3. Be Green - use renewable energy

The third strategy covers the use of renewable technologies.

A feasibility study was carried out for the development and a range of renewable technologies were analysed. The analysis included a biomass heating system, ground-source heat pumps, air-source heat pumps, photovoltaic panels, solar thermal system, and wind turbines.

The analysis identified photovoltaic solar panels as the most suitable technology for this development. The installation of $18m^2$ of PV panels with a rated output of 2.7 kWp will reduce the development's regulated CO_2 emissions by 26.1%.

In total, the development is expected to reduce regulated CO_2 emissions by 23.9% when compared with a notional building built to current Part L Building Regulations (2013), which is a significant saving for a development of this nature.

Appendix A - SAP Worksheets

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

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	62	(1a) x	2.56	(2a) =	158.72	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	62	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	158.72	(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) =	0.19	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.44	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.34	(21)

Infiltration rate modified for monthly wind speed

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

SAP WorkSheet: New dwelling design stage

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

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

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			2.97	x1/[1/(1.3)+ 0.04]		=	3.67			(27)
Windows Type 2			4.77	x1/[1/(1.3)+ 0.04]		=	5.89			(27)
Windows Type 3			3.87	x1/[1/(1.3)+ 0.04]		=	4.78			(27)
Floor			21.53	x	0.2	=	4.306			(28)
Walls Type1	67.48	11.61	55.87	x	0.15	=	8.38			(29)
Walls Type2	20.86	2	18.86	x	0.24	=	4.46			(29)
Roof	6.37	0	6.37	x	0.1	=	0.64			(30)
Total area of elements, m²			116.24							(31)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	35.13	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	10646.15	(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		9.92	(36)

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

Total fabric heat loss	(33) + (36) =	45.05	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.12	30.93	30.74	29.86	29.69	28.92	28.92	28.78	29.22	29.69	30.03	30.37	(38)

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

(39)m=	76.16	75.97	75.78	74.9	74.74	73.97	73.97	73.83	74.27	74.74	75.07	75.42	

Average = Sum(39)$_{1…12}$ /12= 74.9 (39)

SAP WorkSheet: New dwelling design stage

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

(40)m=	1.23	1.23	1.22	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22

Average = Sum(40)$_{1…12}$ /12= 1.21 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.04 (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 82.59 (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=	90.85	87.55	84.24	80.94	77.64	74.33	74.33	77.64	80.94	84.24	87.55	90.85

Total = Sum(44)$_{1…12}$ = 991.11 (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=	134.73	117.84	121.6	106.01	101.72	87.78	81.34	93.34	94.45	110.07	120.15	130.48

Total = Sum(45)$_{1…12}$ = 1299.5 (45)

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

(46)m=	20.21	17.68	18.24	15.9	15.26	13.17	12.2	14	14.17	16.51	18.02	19.57	(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=	46.3	40.3	42.93	39.92	39.56	36.66	37.88	39.56	39.92	42.93	43.17	46.3	(61)

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

(62)m=	181.03	158.13	164.53	145.93	141.28	124.43	119.22	132.9	134.37	153	163.33	176.78	(62)

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

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

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

Output from water heater

(64)m=	181.03	158.13	164.53	145.93	141.28	124.43	119.22	132.9	134.37	153	163.33	176.78	

Output from water heater (annual)$_{1...12}$ 1794.92 (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=	56.37	49.25	51.16	45.23	43.71	38.35	36.51	40.93	41.38	47.33	50.74	54.96	(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=	122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.25	122.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	40.27	35.77	29.09	22.02	16.46	13.9	15.02	19.52	26.2	33.26	38.82	41.39	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	265.61	268.37	261.42	246.64	227.97	210.43	198.71	195.95	202.9	217.69	236.35	253.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	49.26	49.26	49.26	49.26	49.26	49.26	49.26	49.26	49.26	49.26	49.26	49.26	(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=	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	-81.5	(71)
Water heating gains (Table 5)													
(72)m=	75.77	73.3	68.77	62.82	58.75	53.26	49.08	55.01	57.48	63.62	70.48	73.87	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	474.67	470.45	452.29	424.49	396.2	370.61	355.82	363.49	379.59	407.58	438.67	462.17	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.87	x	11.28	x	0.63	x	0.7	=	13.34	(75)
Northeast	0.9x	0.77	x	3.87	x	22.97	x	0.63	x	0.7	=	27.16	(75)
Northeast	0.9x	0.77	x	3.87	x	41.38	x	0.63	x	0.7	=	48.94	(75)
Northeast	0.9x	0.77	x	3.87	x	67.96	x	0.63	x	0.7	=	80.37	(75)
Northeast	0.9x	0.77	x	3.87	x	91.35	x	0.63	x	0.7	=	108.04	(75)

Northeast	0.9x	0.77	x	3.87	x	97.38	x	0.63	x	0.7	=	115.18	(75)
Northeast	0.9x	0.77	x	3.87	x	91.1	x	0.63	x	0.7	=	107.75	(75)
Northeast	0.9x	0.77	x	3.87	x	72.63	x	0.63	x	0.7	=	85.9	(75)
Northeast	0.9x	0.77	x	3.87	x	50.42	x	0.63	x	0.7	=	59.63	(75)
Northeast	0.9x	0.77	x	3.87	x	28.07	x	0.63	x	0.7	=	33.2	(75)
Northeast	0.9x	0.77	x	3.87	x	14.2	x	0.63	x	0.7	=	16.79	(75)
Northeast	0.9x	0.77	x	3.87	x	9.21	x	0.63	x	0.7	=	10.9	(75)
Southwest	0.9x	0.77	x	2.97	x	36.79		0.63	x	0.7	=	33.4	(79)
Southwest	0.9x	0.77	x	2.97	x	62.67		0.63	x	0.7	=	56.89	(79)
Southwest	0.9x	0.77	x	2.97	x	85.75		0.63	x	0.7	=	77.84	(79)
Southwest	0.9x	0.77	x	2.97	x	106.25		0.63	x	0.7	=	96.44	(79)
Southwest	0.9x	0.77	x	2.97	x	119.01		0.63	x	0.7	=	108.02	(79)
Southwest	0.9x	0.77	x	2.97	x	118.15		0.63	x	0.7	=	107.24	(79)
Southwest	0.9x	0.77	x	2.97	x	113.91		0.63	x	0.7	=	103.39	(79)
Southwest	0.9x	0.77	x	2.97	x	104.39		0.63	x	0.7	=	94.75	(79)
Southwest	0.9x	0.77	x	2.97	x	92.85		0.63	x	0.7	=	84.28	(79)
Southwest	0.9x	0.77	x	2.97	x	69.27		0.63	x	0.7	=	62.87	(79)
Southwest	0.9x	0.77	x	2.97	x	44.07		0.63	x	0.7	=	40	(79)
Southwest	0.9x	0.77	x	2.97	x	31.49		0.63	x	0.7	=	28.58	(79)
Northwest	0.9x	0.77	x	4.77	x	11.28	x	0.63	x	0.7	=	16.45	(81)
Northwest	0.9x	0.77	x	4.77	x	22.97	x	0.63	x	0.7	=	33.48	(81)
Northwest	0.9x	0.77	x	4.77	x	41.38	x	0.63	x	0.7	=	60.32	(81)
Northwest	0.9x	0.77	x	4.77	x	67.96	x	0.63	x	0.7	=	99.06	(81)
Northwest	0.9x	0.77	x	4.77	x	91.35	x	0.63	x	0.7	=	133.16	(81)
Northwest	0.9x	0.77	x	4.77	x	97.38	x	0.63	x	0.7	=	141.96	(81)
Northwest	0.9x	0.77	x	4.77	x	91.1	x	0.63	x	0.7	=	132.8	(81)
Northwest	0.9x	0.77	x	4.77	x	72.63	x	0.63	x	0.7	=	105.87	(81)
Northwest	0.9x	0.77	x	4.77	x	50.42	x	0.63	x	0.7	=	73.5	(81)
Northwest	0.9x	0.77	x	4.77	x	28.07	x	0.63	x	0.7	=	40.92	(81)
Northwest	0.9x	0.77	x	4.77	x	14.2	x	0.63	x	0.7	=	20.7	(81)
Northwest	0.9x	0.77	x	4.77	x	9.21	x	0.63	x	0.7	=	13.43	(81)

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

(83)m=	63.19	117.53	187.1	275.88	349.22	364.38	343.94	286.52	217.41	136.98	77.49	52.91	(83)

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

(84)m=	537.86	587.98	639.39	700.37	745.42	734.99	699.76	650.02	597.01	544.57	516.16	515.08	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.92	0.8	0.62	0.46	0.51	0.76	0.94	0.98	0.99	(86)

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

(87)m=	19.9	20.04	20.28	20.6	20.85	20.97	20.99	20.99	20.91	20.6	20.2	19.87	(87)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(88)m=	19.9	19.9	19.9	19.91	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.91	(88)

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

(89)m=	0.99	0.98	0.96	0.89	0.74	0.52	0.35	0.4	0.68	0.91	0.98	0.99	(89)

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

(90)m=	18.46	18.67	19.02	19.47	19.78	19.91	19.92	19.92	19.86	19.48	18.91	18.43	(90)

fLA = Living area ÷ (4) = 0.5 (91)

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

(92)m=	19.18	19.35	19.65	20.04	20.31	20.44	20.46	20.46	20.38	20.04	19.55	19.15	(92)

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

(93)m=	19.18	19.35	19.65	20.04	20.31	20.44	20.46	20.46	20.38	20.04	19.55	19.15	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.95	0.89	0.76	0.57	0.4	0.46	0.71	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	529.66	573.77	609.74	624.85	568.75	417.87	283.28	295.79	426.5	499.07	502.55	508.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1133.17	1097.89	996.53	834.12	643.82	431.76	285.42	299.49	466.76	705.51	934.77	1127.38	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	449.01	352.2	287.77	150.67	55.86	0	0	0	0	153.59	311.19	460.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2220.73 (98)

Space heating requirement in kWh/m²/year 35.82 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		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)													
	449.01	352.2	287.77	150.67	55.86	0	0	0	0	153.59	311.19	460.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	494.51	387.89	316.93	165.93	61.52	0	0	0	0	169.16	342.73	507.08	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 2445.74 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

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

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

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Water heating

Output from water heater (calculated above)

	181.03	158.13	164.53	145.93	141.28	124.43	119.22	132.9	134.37	153	163.33	176.78		
Efficiency of water heater													81.5	(216)
(217)m=	87.92	87.7	87.18	85.97	83.94	81.5	81.5	81.5	81.5	85.91	87.37	88.01		(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	205.91	180.31	188.72	169.74	168.32	152.68	146.28	163.07	164.87	178.1	186.94	200.85		
								Total = Sum(219a)$_{1...12}$ =					2105.78	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2445.74	
Water heating fuel used			2105.78	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			284.47	(232)
Electricity generated by PVs			-593.18	(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 =	85.11	(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 =	73.28	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	37.52	(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) =			319.87	(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] =	1.26	(257)
SAP rating (Section 12)		82.48	(258)

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

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

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Space heating (main system 1)	(211) x	0.216	=	528.28	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	454.85	(264)
Space and water heating	(261) + (262) + (263) + (264) =			983.13	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	147.64	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-307.86	(269)
Total CO2, kg/year		sum of (265)…(271) =		838.48	(272)
CO2 emissions per m²		(272) ÷ (4) =		13.52	(273)
EI rating (section 14)				89	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2983.8	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2569.05	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5552.85	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	873.32	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1821.08	(269)
'Total Primary Energy		sum of (265)…(271) =		4697.2	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		75.76	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
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	52.4	(1a) x	1.92	(2a) =	100.61	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.4	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	100.61	(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) =	0.2	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.45	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

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

0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			2.657	x1/[1/(1.3)+ 0.04]		=	3.28			(27)
Windows Type 2			1.027	x1/[1/(1.3)+ 0.04]		=	1.27			(27)
Windows Type 3			1.027	x1/[1/(1.3)+ 0.04]		=	1.27			(27)
Floor			4.76	x	0.2	=	0.9520001			(28)
Walls Type1	40.6	4.71	35.89	x	0.15	=	5.38			(29)
Walls Type2	3.43	2	1.43	x	0.24	=	0.34			(29)
Roof	43.58	0	43.58	x	0.1	=	4.36			(30)
Total area of elements, m²			92.37							(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) = 19.85 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5020.91 (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 9.2 (36)

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

Total fabric heat loss (33) + (36) = 29.05 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	19.86	19.74	19.61	19.03	18.92	18.41	18.41	18.32	18.61	18.92	19.14	19.37	(38)

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

(39)m=	48.92	48.79	48.67	48.08	47.97	47.47	47.47	47.37	47.66	47.97	48.19	48.43	

Average = $Sum(39)_{1...12}$ /12= 48.08 (39)

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

(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 — 1.76 (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 — 76.02 (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=	83.62	80.58	77.54	74.5	71.46	68.42	68.42	71.46	74.5	77.54	80.58	83.62

Total = $Sum(44)_{1...12}$ = 912.25 (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=	124.01	108.46	111.92	97.58	93.63	80.79	74.87	85.91	86.94	101.32	110.59	120.1

Total = $Sum(45)_{1...12}$ = 1196.1 (45)

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

(46)m=	18.6	16.27	16.79	14.64	14.04	12.12	11.23	12.89	13.04	15.2	16.59	18.01	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year — (48) x (49) = 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=	42.61	37.09	39.51	36.74	36.41	33.74	34.87	36.41	36.74	39.51	39.74	42.61	(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=	166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	(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=	166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	

Output from water heater (annual)$_{1...12}$ 1652.1 (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=	51.89	45.34	47.09	41.63	40.23	35.3	33.61	37.67	38.09	43.57	46.71	50.59	(65)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m=	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	40.37	35.85	29.16	22.07	16.5	13.93	15.05	19.57	26.26	33.35	38.92	41.49	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	229.05	231.43	225.44	212.69	196.59	181.46	171.36	168.98	174.97	187.72	203.82	218.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	(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=	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	(71)
Water heating gains (Table 5)													
(72)m=	69.74	67.46	63.3	57.82	54.08	49.03	45.17	50.63	52.9	58.56	64.87	67.99	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	424.7	420.29	403.43	378.12	352.71	329.96	317.13	324.72	339.68	365.16	393.15	413.97	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	1.03	x	11.28	x	0.63	x	0.7	=	3.54	(75)
Northeast	0.9x	0.77	x	1.03	x	22.97	x	0.63	x	0.7	=	7.21	(75)
Northeast	0.9x	0.77	x	1.03	x	41.38	x	0.63	x	0.7	=	12.99	(75)
Northeast	0.9x	0.77	x	1.03	x	67.96	x	0.63	x	0.7	=	21.33	(75)
Northeast	0.9x	0.77	x	1.03	x	91.35	x	0.63	x	0.7	=	28.67	(75)

Northeast	0.9x	0.77	x	1.03	x	97.38	x	0.63	x	0.7	=	30.57	(75)
Northeast	0.9x	0.77	x	1.03	x	91.1	x	0.63	x	0.7	=	28.59	(75)
Northeast	0.9x	0.77	x	1.03	x	72.63	x	0.63	x	0.7	=	22.8	(75)
Northeast	0.9x	0.77	x	1.03	x	50.42	x	0.63	x	0.7	=	15.83	(75)
Northeast	0.9x	0.77	x	1.03	x	28.07	x	0.63	x	0.7	=	8.81	(75)
Northeast	0.9x	0.77	x	1.03	x	14.2	x	0.63	x	0.7	=	4.46	(75)
Northeast	0.9x	0.77	x	1.03	x	9.21	x	0.63	x	0.7	=	2.89	(75)
Southeast	0.9x	0.77	x	2.66	x	36.79	x	0.63	x	0.7	=	29.88	(77)
Southeast	0.9x	0.77	x	2.66	x	62.67	x	0.63	x	0.7	=	50.89	(77)
Southeast	0.9x	0.77	x	2.66	x	85.75	x	0.63	x	0.7	=	69.63	(77)
Southeast	0.9x	0.77	x	2.66	x	106.25	x	0.63	x	0.7	=	86.28	(77)
Southeast	0.9x	0.77	x	2.66	x	119.01	x	0.63	x	0.7	=	96.64	(77)
Southeast	0.9x	0.77	x	2.66	x	118.15	x	0.63	x	0.7	=	95.94	(77)
Southeast	0.9x	0.77	x	2.66	x	113.91	x	0.63	x	0.7	=	92.5	(77)
Southeast	0.9x	0.77	x	2.66	x	104.39	x	0.63	x	0.7	=	84.77	(77)
Southeast	0.9x	0.77	x	2.66	x	92.85	x	0.63	x	0.7	=	75.4	(77)
Southeast	0.9x	0.77	x	2.66	x	69.27	x	0.63	x	0.7	=	56.25	(77)
Southeast	0.9x	0.77	x	2.66	x	44.07	x	0.63	x	0.7	=	35.79	(77)
Southeast	0.9x	0.77	x	2.66	x	31.49	x	0.63	x	0.7	=	25.57	(77)
Northwest	0.9x	0.77	x	1.03	x	11.28	x	0.63	x	0.7	=	3.54	(81)
Northwest	0.9x	0.77	x	1.03	x	22.97	x	0.63	x	0.7	=	7.21	(81)
Northwest	0.9x	0.77	x	1.03	x	41.38	x	0.63	x	0.7	=	12.99	(81)
Northwest	0.9x	0.77	x	1.03	x	67.96	x	0.63	x	0.7	=	21.33	(81)
Northwest	0.9x	0.77	x	1.03	x	91.35	x	0.63	x	0.7	=	28.67	(81)
Northwest	0.9x	0.77	x	1.03	x	97.38	x	0.63	x	0.7	=	30.57	(81)
Northwest	0.9x	0.77	x	1.03	x	91.1	x	0.63	x	0.7	=	28.59	(81)
Northwest	0.9x	0.77	x	1.03	x	72.63	x	0.63	x	0.7	=	22.8	(81)
Northwest	0.9x	0.77	x	1.03	x	50.42	x	0.63	x	0.7	=	15.83	(81)
Northwest	0.9x	0.77	x	1.03	x	28.07	x	0.63	x	0.7	=	8.81	(81)
Northwest	0.9x	0.77	x	1.03	x	14.2	x	0.63	x	0.7	=	4.46	(81)
Northwest	0.9x	0.77	x	1.03	x	9.21	x	0.63	x	0.7	=	2.89	(81)

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

(83)m=	36.96	65.31	95.61	128.94	153.98	157.07	149.68	130.36	107.05	73.86	44.7	31.35	(83)

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

(84)m=	461.66	485.6	499.04	507.06	506.69	487.03	466.81	455.08	446.73	439.03	437.85	445.32	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.91	0.8	0.61	0.45	0.48	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=	20.32	20.42	20.58	20.77	20.92	20.99	21	21	20.97	20.81	20.54	20.3	(87)

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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=	0.98	0.97	0.95	0.88	0.75	0.54	0.36	0.39	0.63	0.88	0.96	0.98	(89)

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

(90)m=	19.26	19.4	19.62	19.9	20.08	20.15	20.16	20.16	20.14	19.95	19.58	19.23	(90)

fLA = Living area ÷ (4) = 0.75 (91)

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

(92)m=	20.06	20.16	20.34	20.56	20.71	20.78	20.79	20.79	20.76	20.6	20.3	20.03	(92)

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

(93)m=	20.06	20.16	20.34	20.56	20.71	20.78	20.79	20.79	20.76	20.6	20.3	20.03	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.9	0.78	0.59	0.42	0.45	0.68	0.89	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	452.68	471.75	474.52	454.94	396.32	287.9	198.22	206.98	304.97	392.16	422.42	438.03	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	770.85	744.76	673.43	560.43	432.34	293.3	198.85	207.91	317.58	479.57	636.31	766.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	236.72	183.46	147.99	75.96	26.8	0	0	0	0	65.03	154	244.59	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1134.54 (98)

Space heating requirement in kWh/m²/year 21.65 (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)													
	236.72	183.46	147.99	75.96	26.8	0	0	0	0	65.03	154	244.59	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	260.7	202.05	162.98	83.65	29.51	0	0	0	0	71.62	169.6	269.38	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1249.49 (211)

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

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

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

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Water heating

Output from water heater (calculated above)

166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71

Efficiency of water heater 81.5 (216)

(217)m=	86.71	86.44	85.85	84.63	82.95	81.5	81.5	81.5	81.5	84.23	85.95	86.84	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	192.16	168.39	176.4	158.71	156.77	140.53	134.64	150.09	151.75	167.21	174.9	187.37

Total = Sum(219a)$_{1...12}$ = 1958.9 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1249.49	
Water heating fuel used			1958.9	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			285.16	(232)
Electricity generated by PVs			-501.93	(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 =	43.48	(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 =	68.17	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	3.96	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	37.61	(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) = 273.22 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.18	(257)
SAP rating (Section 12)		83.56	(258)

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

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

Space heating (main system 1)	(211) x	0.216	=	269.89	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	423.12	(264)
Space and water heating	(261) + (262) + (263) + (264) =			693.01	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	148	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-260.5	(269)
Total CO2, kg/year	sum of (265)…(271) =			596.08	(272)
CO2 emissions per m²	(272) ÷ (4) =			11.38	(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	=	1524.38	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2389.86	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3914.24	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	875.44	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1540.91	(269)
'Total Primary Energy	sum of (265)…(271) =			3340.87	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			63.76	(273)

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User Details:

Assessor Name: **Stroma Number:**
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	51.3	(1a) x	1.92	(2a) =	98.5	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	51.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	98.5	(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)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.2	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.45	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.4	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			1.63	x1/[1/(1.3)+ 0.04]		=	2.01			(27)
Windows Type 2			3.684	x1/[1/(1.3)+ 0.04]		=	4.55			(27)
Floor			3.46	x	0.2	=	0.692			(28)
Walls Type1	24.82	5.31	19.51	x	0.15	=	2.93			(29)
Walls Type2	7.66	2	5.66	x	0.24	=	1.34			(29)
Roof	42.77	0	42.77	x	0.1	=	4.28			(30)
Total area of elements, m²			78.71							(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) = 18.8 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 3533.57 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.84 (36)

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

Total fabric heat loss (33) + (36) = 26.64 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	19.51	19.38	19.26	18.68	18.57	18.06	18.06	17.97	18.26	18.57	18.79	19.02	(38)

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

(39)m=	46.15	46.02	45.9	45.31	45.21	44.7	44.7	44.6	44.89	45.21	45.43	45.66	

Average = $Sum(39)_{1…12}$ /12= 45.31 (39)

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

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

Average = Sum(40)$_{1\ldots12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.73 (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 75.25 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	82.77	79.76	76.75	73.74	70.73	67.72	67.72	70.73	73.74	76.75	79.76	82.77	
									Total = Sum(44)$_{1\ldots12}$ =			903	(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=	122.75	107.36	110.79	96.59	92.68	79.97	74.11	85.04	86.05	100.29	109.47	118.88	
									Total = Sum(45)$_{1\ldots12}$ =			1183.97	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.41	16.1	16.62	14.49	13.9	12	11.12	12.76	12.91	15.04	16.42	17.83	(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)

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

(61)m=	42.18	36.71	39.11	36.37	36.05	33.4	34.51	36.05	36.37	39.11	39.34	42.18	(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=	164.93	144.07	149.9	132.95	128.72	113.37	108.62	121.08	122.42	139.4	148.81	161.06	(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=	164.93	144.07	149.9	132.95	128.72	113.37	108.62	121.08	122.42	139.4	148.81	161.06	

Output from water heater (annual)1…12 | 1635.35 | (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=	51.36	44.88	46.61	41.21	39.83	34.94	33.27	37.29	37.7	43.12	46.23	50.07	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	103.71	103.71	103.71	103.71	103.71	103.71	103.71	103.71	103.71	103.71	103.71	103.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	38.47	34.17	27.79	21.04	15.73	13.28	14.35	18.65	25.03	31.78	37.09	39.54	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	224.79	227.12	221.24	208.73	192.93	178.09	168.17	165.84	171.72	184.23	200.03	214.87	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	47.1	47.1	47.1	47.1	47.1	47.1	47.1	47.1	47.1	47.1	47.1	47.1	(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=	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	-69.14	(71)
Water heating gains (Table 5)													
(72)m=	69.03	66.78	62.65	57.23	53.53	48.53	44.72	50.12	52.37	57.96	64.21	67.3	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	416.96	412.74	396.36	371.67	346.86	324.56	311.9	319.27	333.78	358.64	386	406.38	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	1.63	x	36.79	x	0.63	x	0.7	=	18.33	(77)
Southeast 0.9x	0.77	x	1.63	x	62.67	x	0.63	x	0.7	=	31.22	(77)
Southeast 0.9x	0.77	x	1.63	x	85.75	x	0.63	x	0.7	=	42.72	(77)
Southeast 0.9x	0.77	x	1.63	x	106.25	x	0.63	x	0.7	=	52.93	(77)
Southeast 0.9x	0.77	x	1.63	x	119.01	x	0.63	x	0.7	=	59.29	(77)

Southeast	0.9x	0.77	x	1.63	x	118.15	x	0.63	x	0.7	=	58.86	(77)
Southeast	0.9x	0.77	x	1.63	x	113.91	x	0.63	x	0.7	=	56.74	(77)
Southeast	0.9x	0.77	x	1.63	x	104.39	x	0.63	x	0.7	=	52	(77)
Southeast	0.9x	0.77	x	1.63	x	92.85	x	0.63	x	0.7	=	46.25	(77)
Southeast	0.9x	0.77	x	1.63	x	69.27	x	0.63	x	0.7	=	34.51	(77)
Southeast	0.9x	0.77	x	1.63	x	44.07	x	0.63	x	0.7	=	21.95	(77)
Southeast	0.9x	0.77	x	1.63	x	31.49	x	0.63	x	0.7	=	15.69	(77)
Southwest	0.9x	0.77	x	3.68	x	36.79		0.63	x	0.7	=	41.43	(79)
Southwest	0.9x	0.77	x	3.68	x	62.67		0.63	x	0.7	=	70.56	(79)
Southwest	0.9x	0.77	x	3.68	x	85.75		0.63	x	0.7	=	96.55	(79)
Southwest	0.9x	0.77	x	3.68	x	106.25		0.63	x	0.7	=	119.63	(79)
Southwest	0.9x	0.77	x	3.68	x	119.01		0.63	x	0.7	=	133.99	(79)
Southwest	0.9x	0.77	x	3.68	x	118.15		0.63	x	0.7	=	133.02	(79)
Southwest	0.9x	0.77	x	3.68	x	113.91		0.63	x	0.7	=	128.25	(79)
Southwest	0.9x	0.77	x	3.68	x	104.39		0.63	x	0.7	=	117.53	(79)
Southwest	0.9x	0.77	x	3.68	x	92.85		0.63	x	0.7	=	104.54	(79)
Southwest	0.9x	0.77	x	3.68	x	69.27		0.63	x	0.7	=	77.99	(79)
Southwest	0.9x	0.77	x	3.68	x	44.07		0.63	x	0.7	=	49.62	(79)
Southwest	0.9x	0.77	x	3.68	x	31.49		0.63	x	0.7	=	35.45	(79)

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

(83)m=	59.75	101.78	139.26	172.56	193.28	191.88	184.99	169.53	150.79	112.49	71.57	51.14	(83)

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

(84)m=	476.72	514.52	535.62	544.22	540.14	516.44	496.89	488.8	484.57	471.13	457.57	457.52	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.87	0.74	0.55	0.4	0.42	0.62	0.86	0.96	0.98	(86)

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

(87)m=	20.42	20.53	20.68	20.85	20.96	20.99	21	21	20.99	20.88	20.63	20.39	(87)

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

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

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

(89)m=	0.97	0.96	0.92	0.83	0.68	0.48	0.32	0.35	0.56	0.82	0.95	0.98	(89)

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

(90)m=	19.41	19.58	19.79	20.02	20.14	20.19	20.19	20.19	20.18	20.06	19.73	19.38	(90)

fLA = Living area ÷ (4) = | 0.75 | (91)

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

(92)m=	20.17	20.29	20.46	20.64	20.75	20.79	20.8	20.8	20.78	20.67	20.4	20.14	(92)

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

(93)m=	20.17	20.29	20.46	20.64	20.75	20.79	20.8	20.8	20.78	20.67	20.4	20.14	(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	0.96	0.93	0.85	0.72	0.53	0.38	0.4	0.61	0.85	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	464.24	492.67	495.46	463.69	389.04	274.27	187.37	195.78	294.32	399.02	434.89	447.62	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	732.2	708.38	640.76	532.12	409.21	276.8	187.62	196.15	300.1	455.26	604.33	727.7	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	199.36	144.95	108.1	49.27	15.01	0	0	0	0	41.85	122	208.38	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 888.92 (98)

Space heating requirement in kWh/m²/year 17.33 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		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)													
	199.36	144.95	108.1	49.27	15.01	0	0	0	0	41.85	122	208.38	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	219.56	159.64	119.05	54.26	16.53	0	0	0	0	46.08	134.36	229.49	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 978.99 (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)													
	164.93	144.07	149.9	132.95	128.72	113.37	108.62	121.08	122.42	139.4	148.81	161.06	
Efficiency of water heater													81.5 (216)
(217)m=	86.34	85.91	85.15	83.82	82.38	81.5	81.5	81.5	81.5	83.47	85.44	86.5	(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m													
(219)m=	191.03	167.7	176.03	158.62	156.25	139.11	133.27	148.57	150.21	167	174.16	186.2	

Total = Sum(219a)$_{1...12}$ = 1948.16 (219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		978.99

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Water heating fuel used			1948.16	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			271.78	(232)
Electricity generated by PVs			-494.32	(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 =	34.07	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	67.8	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	35.85	(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) =	261.67	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.14	(257)
SAP rating (Section 12)		84.08	(258)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	211.46	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	420.8	(264)
Space and water heating	(261) + (262) + (263) + (264) =			632.26	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	141.05	(268)
Energy saving/generation technologies Item 1		0.519	=	-256.55	(269)
Total CO2, kg/year		sum of (265)…(271) =		532.33	(272)

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CO2 emissions per m²	(272) ÷ (4) =		10.38	(273)
EI rating (section 14)			93	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1194.37	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2376.75	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3571.12	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	834.35	(268)
Energy saving/generation technologies Item 1		3.07	=	-1517.56	(269)
'Total Primary Energy		sum of (265)…(271) =		2980.01	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		58.09	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Flat 10

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	47.8	(1a) x	1.92	(2a) =	91.78	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	47.8	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	91.78	(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) =	0.22	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.47	(18)

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

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(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

0.46	0.45	0.44	0.4	0.39	0.34	0.34	0.34	0.36	0.39	0.41	0.43

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

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

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

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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	x	1.5	=	3			(26)
Windows Type 1			1.63	x1/[1/(1.3)+ 0.04]		=	2.01			(27)
Windows Type 2			3.87	x1/[1/(1.3)+ 0.04]		=	4.78			(27)
Walls Type1	45.48	5.5	39.98	x	0.15	=	6			(29)
Walls Type2	17.33	2	15.33	x	0.24	=	3.62			(29)
Roof	40.79	0	40.79	x	0.1	=	4.08			(30)
Total area of elements, m²			103.6							(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) = 23.49 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 6450.77 (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 10.4 (36)

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

Total fabric heat loss (33) + (36) = 33.89 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	18.38	18.25	18.13	17.55	17.44	16.94	16.94	16.85	17.13	17.44	17.66	17.89	(38)

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

(39)m=	52.27	52.15	52.02	51.45	51.34	50.83	50.83	50.74	51.03	51.34	51.56	51.79	

Average = Sum(39)$_{1…12}$ /12= 51.45 (39)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(40)m=	1.09	1.09	1.09	1.08	1.07	1.06	1.06	1.06	1.07	1.07	1.08	1.08

Average = Sum(40)$_{1…12}$ /12= 1.08 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.63 (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 — 72.81 (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=	80.09	77.18	74.26	71.35	68.44	65.53	65.53	68.44	71.35	74.26	77.18	80.09

Total = Sum(44)$_{1…12}$ = 873.69 (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=	118.77	103.88	107.19	93.45	89.67	77.38	71.7	82.28	83.26	97.03	105.92	115.02

Total = Sum(45)$_{1…12}$ = 1145.54 (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=	17.82	15.58	16.08	14.02	13.45	11.61	10.76	12.34	12.49	14.55	15.89	17.25	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b — 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

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

Enter (50) or (54) in (55) — 0 (55)

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

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

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

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

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

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

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

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

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

(61)m=	40.81	35.52	37.84	35.19	34.88	32.31	33.39	34.88	35.19	37.84	38.06	40.81	(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=	159.58	139.4	145.03	128.64	124.54	109.69	105.09	117.15	118.45	134.88	143.98	155.83	(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=	159.58	139.4	145.03	128.64	124.54	109.69	105.09	117.15	118.45	134.88	143.98	155.83	

Output from water heater (annual)$_{1...12}$ 1582.27 (64)

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

(65)m=	49.69	43.42	45.1	39.87	38.53	33.81	32.19	36.08	36.48	41.72	44.73	48.45	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	97.53	97.53	97.53	97.53	97.53	97.53	97.53	97.53	97.53	97.53	97.53	97.53	(66)

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

(67)m=	35.34	31.39	25.52	19.32	14.44	12.19	13.18	17.13	22.99	29.19	34.07	36.32	(67)

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

(68)m=	211.23	213.42	207.9	196.14	181.29	167.34	158.02	155.83	161.36	173.11	187.96	201.91	(68)

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

(69)m=	46.38	46.38	46.38	46.38	46.38	46.38	46.38	46.38	46.38	46.38	46.38	46.38	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	-65.02	(71)

Water heating gains (Table 5)

(72)m=	66.79	64.61	60.62	55.37	51.79	46.95	43.26	48.49	50.67	56.08	62.13	65.12	(72)

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

(73)m=	395.25	391.31	375.93	352.73	329.42	308.38	296.36	303.34	316.9	340.28	366.05	385.24	(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)	
Southwest 0.9x	0.77	x	1.63	x	36.79	0.63	x	0.7	=	18.33	(79)
Southwest 0.9x	0.77	x	1.63	x	62.67	0.63	x	0.7	=	31.22	(79)
Southwest 0.9x	0.77	x	1.63	x	85.75	0.63	x	0.7	=	42.72	(79)
Southwest 0.9x	0.77	x	1.63	x	106.25	0.63	x	0.7	=	52.93	(79)
Southwest 0.9x	0.77	x	1.63	x	119.01	0.63	x	0.7	=	59.29	(79)

Southwest	0.9x	0.77	x	1.63	x	118.15		0.63	x	0.7	=	58.86	(79)
Southwest	0.9x	0.77	x	1.63	x	113.91		0.63	x	0.7	=	56.74	(79)
Southwest	0.9x	0.77	x	1.63	x	104.39		0.63	x	0.7	=	52	(79)
Southwest	0.9x	0.77	x	1.63	x	92.85		0.63	x	0.7	=	46.25	(79)
Southwest	0.9x	0.77	x	1.63	x	69.27		0.63	x	0.7	=	34.51	(79)
Southwest	0.9x	0.77	x	1.63	x	44.07		0.63	x	0.7	=	21.95	(79)
Southwest	0.9x	0.77	x	1.63	x	31.49		0.63	x	0.7	=	15.69	(79)
Northwest	0.9x	0.77	x	3.87	x	11.28	x	0.63	x	0.7	=	13.34	(81)
Northwest	0.9x	0.77	x	3.87	x	22.97	x	0.63	x	0.7	=	27.16	(81)
Northwest	0.9x	0.77	x	3.87	x	41.38	x	0.63	x	0.7	=	48.94	(81)
Northwest	0.9x	0.77	x	3.87	x	67.96	x	0.63	x	0.7	=	80.37	(81)
Northwest	0.9x	0.77	x	3.87	x	91.35	x	0.63	x	0.7	=	108.04	(81)
Northwest	0.9x	0.77	x	3.87	x	97.38	x	0.63	x	0.7	=	115.18	(81)
Northwest	0.9x	0.77	x	3.87	x	91.1	x	0.63	x	0.7	=	107.75	(81)
Northwest	0.9x	0.77	x	3.87	x	72.63	x	0.63	x	0.7	=	85.9	(81)
Northwest	0.9x	0.77	x	3.87	x	50.42	x	0.63	x	0.7	=	59.63	(81)
Northwest	0.9x	0.77	x	3.87	x	28.07	x	0.63	x	0.7	=	33.2	(81)
Northwest	0.9x	0.77	x	3.87	x	14.2	x	0.63	x	0.7	=	16.79	(81)
Northwest	0.9x	0.77	x	3.87	x	9.21	x	0.63	x	0.7	=	10.9	(81)

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

(83)m=	31.67	58.38	91.66	133.3	167.32	174.04	164.49	137.9	105.89	67.7	38.74	26.58	(83)

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

(84)m=	426.92	449.69	467.59	486.03	496.74	482.42	460.85	441.24	422.79	407.98	404.79	411.82	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.93	0.82	0.65	0.48	0.52	0.76	0.93	0.98	0.99	(86)

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

(87)m=	20.1	20.21	20.4	20.66	20.86	20.97	21	20.99	20.94	20.69	20.36	20.08	(87)

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

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

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

(89)m=	0.98	0.98	0.96	0.9	0.77	0.56	0.38	0.42	0.68	0.9	0.97	0.99	(89)

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

(90)m=	18.84	18.99	19.27	19.63	19.89	20.01	20.03	20.03	19.98	19.69	19.22	18.81	(90)

fLA = Living area ÷ (4) = | 0.75 | (91)

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

(92)m=	19.79	19.91	20.12	20.4	20.62	20.73	20.75	20.75	20.7	20.44	20.08	19.76	(92)

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

(93)m=	19.79	19.91	20.12	20.4	20.62	20.73	20.75	20.75	20.7	20.44	20.08	19.76	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.98	0.96	0.91	0.81	0.62	0.45	0.49	0.73	0.92	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	419.7	438.88	448.23	442.95	400.14	300.37	209.38	218.08	310.01	373.91	393.1	405.89	(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=	809.62	782.51	708.41	591.59	458.04	311.72	211.14	220.81	336.61	505.23	669.04	805.95	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	290.1	230.92	193.58	107.02	43.08	0	0	0	0	97.7	198.67	297.65	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1458.72 (98)

Space heating requirement in kWh/m²/year 30.52 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		90.8	(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)														
	290.1	230.92	193.58	107.02	43.08	0	0	0	0	97.7	198.67	297.65		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	319.49	254.32	213.19	117.86	47.44	0	0	0	0	107.6	218.8	327.8		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1606.52	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	159.58	139.4	145.03	128.64	124.54	109.69	105.09	117.15	118.45	134.88	143.98	155.83		
Efficiency of water heater													81.5	(216)
(217)m=	87.27	87.06	86.57	85.48	83.7	81.5	81.5	81.5	81.5	85.16	86.65	87.37		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	182.87	160.12	167.54	150.5	148.79	134.59	128.95	143.75	145.33	158.37	166.17	178.35		
Total = Sum(219a)$_{1...12}$ =													1865.32	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1606.52

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Water heating fuel used			1865.32	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			249.62	(232)
Electricity generated by PVs			-456.3	(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 =	55.91	(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 =	64.91	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

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

Energy for lighting	(232)	13.19	x 0.01 =	32.93	(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) =			277.7	(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] =	1.26	(257)
SAP rating (Section 12)		82.47	(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	=	347.01	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	402.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =			749.92	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	129.55	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-236.82	(269)
Total CO2, kg/year		sum of (265)…(271) =		658.22	(272)

CO2 emissions per m²	(272) ÷ (4) =		13.77	(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	=	1959.95	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2275.69	(264)
Space and water heating	(261) + (262) + (263) + (264) =			4235.64	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	766.35	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1400.83	(269)
‘Total Primary Energy	sum of (265)…(271) =			3693.26	(272)
Primary energy kWh/m²/year	(272) ÷ (4) =			77.26	(273)

Appendix B - Overheating Assessments

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 25 October 2016

Property Details: Flat 7

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	314.27	**(P1)**
Transmission heat loss coefficient:	45	
Summer heat loss coefficient:	359.31	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South West (W1)	0	1
North West (W2)	0	1
North East (W3)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South West (W1)	1	0.9	1	0.9	**(P8)**
North West (W2)	1	0.9	1	0.9	**(P8)**
North East (W3)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South West (W1)	0.9 x	2.97	119.92	0.63	0.7	0.9	127.23	
North West (W2)	0.9 x	4.77	98.85	0.63	0.7	0.9	168.42	
North East (W3)	0.9 x	3.87	98.85	0.63	0.7	0.9	136.64	
						Total	432.29	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	367.61	352.82	360.49	
Total summer gains	830.5	785.11	728.76	**(P5)**
Summer gain/loss ratio	2.31	2.19	2.03	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.56	20.34	20.08	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 25 October 2016

Property Details: Flat 8

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	199.2	**(P1)**
Transmission heat loss coefficient:	29.1	
Summer heat loss coefficient:	228.26	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South East (W1)	0	1
North West (W2)	0	1
North East (W3)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South East (W1)	1	0.9	1	0.9	**(P8)**
North West (W2)	1	0.9	1	0.9	**(P8)**
North East (W3)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (W1)	0.9 x	2.66	119.92	0.63	0.7	0.9	113.82	
North West (W2)	0.9 x	1.03	98.85	0.63	0.7	0.9	36.26	
North East (W3)	0.9 x	1.03	98.85	0.63	0.7	0.9	36.26	
						Total	186.34	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	326.96	314.13	321.72	
Total summer gains	524.74	500.47	487.23	**(P5)**
Summer gain/loss ratio	2.3	2.19	2.13	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.55	20.34	20.18	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 25 October 2016

Property Details: Flat 9

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	195.02	**(P1)**
Transmission heat loss coefficient:	26.6	
Summer heat loss coefficient:	221.66	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South East (W1)	0	1
South West (W2)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South East (W1)	1	0.9	1	0.9	**(P8)**
South West (W2)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (W1)	0.9 x	1.63	119.92	0.63	0.7	0.9	69.83	
South West (W2)	0.9 x	3.68	119.92	0.63	0.7	0.9	157.81	
						Total	227.64	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	321.56	308.9	316.27	
Total summer gains	560.53	536.54	528.63	**(P5)**
Summer gain/loss ratio	2.53	2.42	2.38	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.78	20.57	20.43	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Not significant**	

Assessment of likelihood of high internal temperature: Slight

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 25 October 2016

Property Details: Flat 10

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	181.72	**(P1)**
Transmission heat loss coefficient:	33.9	
Summer heat loss coefficient:	215.61	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South West (W1)	0	1
North West (W2)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South West (W1)	1	0.9	1	0.9	**(P8)**
North West (W2)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South West (W1)	0.9 x	1.63	119.92	0.63	0.7	0.9	69.83	
North West (W2)	0.9 x	3.87	98.85	0.63	0.7	0.9	136.64	
						Total	206.47	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	305.38	293.36	300.34	
Total summer gains	526.2	499.82	477.27	**(P5)**
Summer gain/loss ratio	2.44	2.32	2.21	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.69	20.47	20.26	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant